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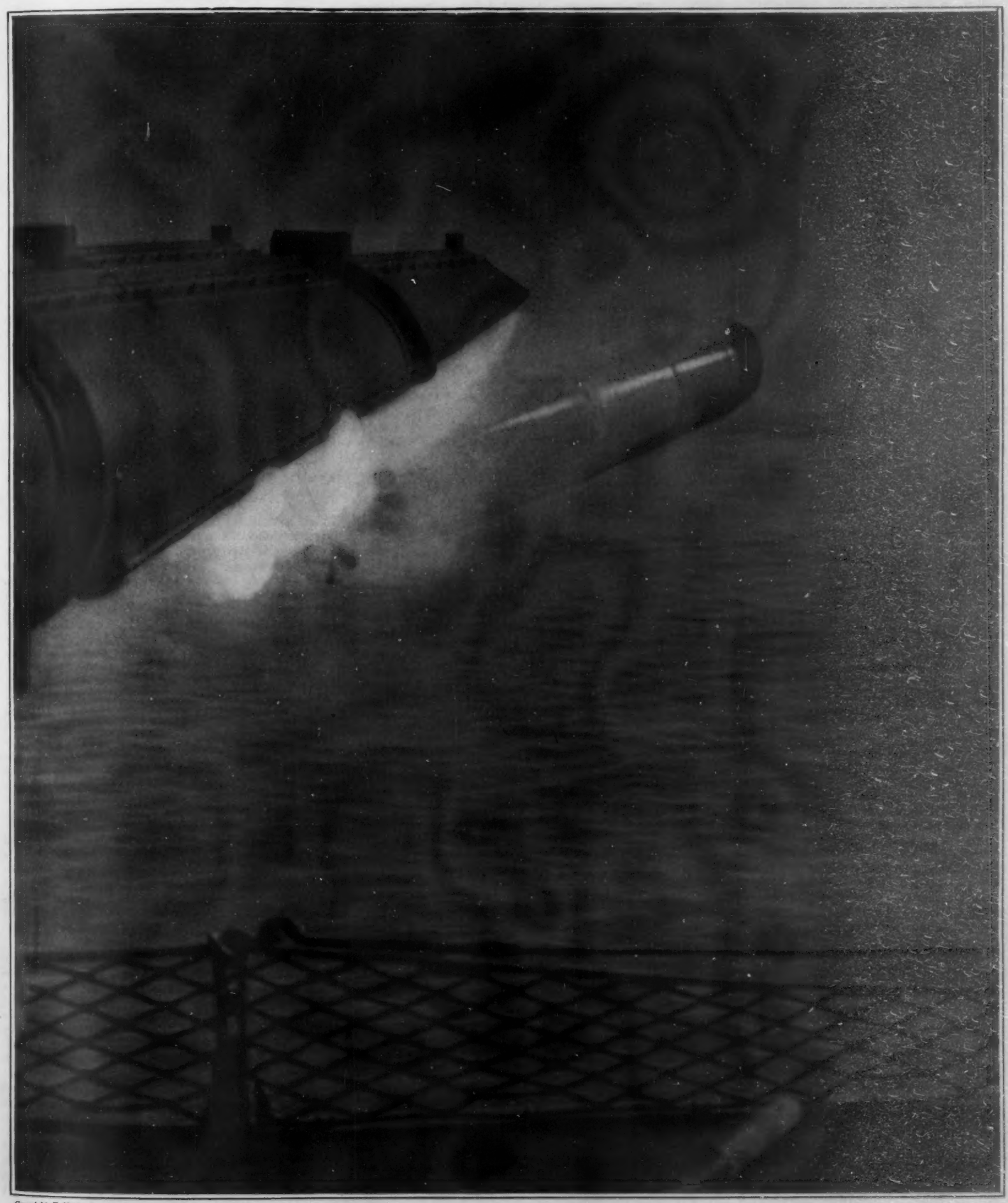

The discharge of one of the new 21-inch torpedoes from a surface launching tube

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Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Scientific American and the Navy Department

WHEN the United States, at the time when Mr. Whitney was Secretary of the Navy, determined to bestir itself and build a steel navy along modern lines, the SCIENTIFIC AMERICAN realised that the size of the new Navy and the speed with which the ships would be built and put into commission, would depend very largely upon the interest in the great project which might be aroused in Congress and throughout the country at large. We realized, further, that before interest could be stimulated, there must be intelligent knowledge of the subject, and we decided to devote a certain amount of space in our columns to the new Navy, illustrating the leading features of the various ships, as soon as the Navy Department saw fit to make them public; describing the various duties to be performed by each type of ship; and showing why, if we were to possess a navy, it should be of a size commensurate with the growing needs of the country, and having a definite relation to the strength of those foreign navies with which at any time it might be called upon to contend.

The result has more than justified our expectations. Not only has our literature on this subject proved to be highly popular, but we feel justified in stating, with all modesty, our belief that this effort on the part of the SCIENTIFIC AMERICAN has been a potent influence in promoting our growth as a naval power. This conviction is based not alone upon expressions of approval from our subscribers, but upon the receipt of many letters from Congressmen and from various officials in the Navy Department, expressing recognition of the work which we were doing in the interests of the Navy.

As our readers are well aware, we have occasionally felt called upon to play the part of critic; but in every case our criticisms have been made with impartiality; without any personal feeling whatsoever; and with the sole desire to secure the best possible results for the monies which have been appropriated.

Such a case has arisen in connection with the great battle-cruisers which form the most novel, if not the most important element in the great program of new construction which the present administration has so judiciously and and so generously undertaken. Criticism is always a thankless task, and we have never undertaken it except with the strong conviction that it was a duty imposed upon us by a consideration of the highest interests of the nation at large. It was solely because we felt that those interests were being placed in jeopardy, that our Editor recently went before the Senate Naval Committee and laid before it that feature in our new battle-cruisers, the exposed position of the boiler plant, to which we have so frequently referred in our columns.

It is needless to say that our action in this matter was not intended as any criticism of the two Bureaus of the Navy which are immediately concerned with the designs of these ships. Always, what we have written has been written in a friendly spirit. The gentlemen who are responsible for these designs will realize, surely, as we do, that the interests of the nation are greater than those of any particular Bureau of the Navy. And if they look at this whole question from the proper angle, they will agree with us that the submission of this most serious question to a board of experts, composed of exline officers of the Navy, and of engineers and naval architects who are not intimately connected either with the Navy Department or the private shipbuilding firms, will be the only prudent course to take in a question of such grave national importance as this.

It is most unfortunate that the major question of the behavior of these important ships in time of battle has been obscured by the comparatively minor question of what kind of drive should be employed. Personally, we care very little whether these ships employ the electric drive or the geared drive; but we do care very much indeed whether they shall have their boilers above the water-line, where they can be completely shot away, or whether they shall carry them where they properly belong, beneath the shelter of the protective deck.

If the proposed board should decide that the electric drive must go in, then let the designs be recast and the ships be enlarged to accommodate all the boiler plant below deck, even though this may involve two or three months' delay. If, on the other hand, they decide that the geared drive, which Admiral Griffin, Chief Engineer, has endorsed by recommending it for our 90,000 horse-power scouts, would be a practicable drive for the battle-cruisers, the problem will be solved with practically no delay whatever.

The Scout Patrols and the Navy Department

THE almost pre-eminent importance of methods and weapons of defense against submarine warfare, in view of the obtaining situation and in the light of European experience during the past 30 months, is so obvious as to require no emphasis. That this fact is thoroughly recognized by the Federal authorities, and particularly by the Navy Department, is evidenced by the efforts that are being made by the Government and by various bodies and associations of private individuals interested in national protection, to augment the numbers of small craft available as scouts and submarine detectors and chasers, and to foster the construction of such vessels and their manning and equipment. While a good deal has been accomplished, very much more remains to be done, and it is therefore doubly unfortunate that a spirit of complete coöperation and coördination does not seem to have been reached between the officials of the Navy engaged in this work and the different groups of public-spirited citizens patriotically endeavoring to help the country.

The difficulty appears to be not so much unwillingness or disinclination of the officials and officers of the Navy primarily responsible for this work, as it does a lack of centralization of control and an unsystematic and inadequately informed method of procedure. In this connection, we refer particularly to the enrolling of the so-called "scout patrols" or fast motor boats to be used as submarine chasers. From certain sources we have obtained absolutely authentic information that the work is not progressing as satisfactorily or as rapidly as might be desired and as the Navy Department intimates. While a considerable number of such boats has been enrolled and can be called upon for service should an emergency arise, the total is quite inadequate, and in many instances information as to the particulars of these craft and their capabilities, and data regarding the personnel of their crews, seems to be wofully wanting in the Department records. Furthermore, there is a lamentable difference of opinion among certain of the officers of the navy engaged in this work regarding the manner in which it should be carried out, and with respect to the eventual utilation of isthe boats and crews. This difference of opinion is, as we have already indicated, mainly due to the fact that the entire scheme and its organization are not under one centralized head responsible for the work as a whole. It is delegated in too great measure to various individual officers in the different districts.

It is gratifying to be able to refer to an exception to the general criticism which we are constrained to voice, in the way in which the work has been carried on in the Second Naval District under its former commandant, Admiral Knight, and its present head, Captain Sims. We have every reason to believe that the scout patrol system and the organization of small craft for defense against submarine attacks in the Second District, extending from Chatham on Cape Cod, to New London, Conn., and including the all-important "back door" to New York City, has advanced further and is in better working order than in any of the other districts, and it is to be sincerely hoped that the good example set will immediately be followed elsewhere.

Navigation in the Kara Sea

UNDER exigencies of the war at least one commercial advance has been made which would probably have been impossible under any other circumstances. Going into the conflict as much in persuit of her long standing aim of an all-year port, Russia has found that pending the issue of the struggle, she is cut off from even such maritime facilities as she has heretofore enjoyed. No ships can enter or leave the Baltic, the Black Sea is likewise locked to the Czar, even the few months of usefulness which he has been accustomed to getting out of Archangel has been impaired by the ubiquitous submarine.

It is not so much a question of munition imports—these can come in over the Trans-Siberian railroad, expensive and inconvenient as the route is. But the economic life of Siberia has been gravely threatened. With the facilities of the railroad strained to the ultimate by the necessity of keeping the supply of war materials up to the mark, the Siberian grain grower has not known where to turn for a market for his product. The transport of grain in competition with munitions and over 2,700 miles of single track railroad would cost more than the value of the grain itself.

But the situation has been saved by the development of new Arctic ports in connection with the river system of Russia's great Asiatic appendix. The Yenesei and its tributaries furnish a network of waterways which are available for the transportation of goods at comparatively small cost, if only things can be so arranged that this transportation will take the goods somewhere. And this has been done; repeated success has demonstrated that navigation of the Kara Sea, into which this great drainage system empties, is feasible during a sufficient part of the year to make practical the operation of a seasonal service somewhat on the order of that planned for Canada through Hudson Bay.

To be sure the route is not an easy one. While the Kara Sea may be entered from the west through any one of three narrow straits, the volume of ice formed each winter, to break up and melt the following summer, is great enough to cause conditions formidable to navigation. Dr. Nansen has investigated the matter closely, and finds that this volume is variable within very wide limits, and not subject to any control. But systematic observation and investigation of conditions governing the ice formation, together with actual experience accumulated by a small concern which has been engaged in this traffic for the past six years, makes it clear that with proper regulation entrance and exit of ships may be rendered possible for at least five to eight weeks each year.

War Cripples and Accident Indemnity

A FEATURE in which the present war differs from any that have preceded it is the intelligent and determined effort made in all the belligerent countries to reduce the human scrap-heap to the lowest possible dimensions. In other words, the lame, the halt, and the blind are so far as possible encouraged and trained to be self-supporting, either wholly or in part, and employers are urged to make use of the services of these crippled defenders of the nation. One of the prime instigators and supporters of this movement has been the brilliant thinker and energetic man of action, M. Herriot, former Mayor of Lyons, and very recently made a member of the Cabinet. He will, no doubt, make use of his new opportunities and power to further this admirable plan of utilizing such broken men as part of the nation's assets instead of letting them become idle and hopeless derelicts as pensioners and inmates of soldiers' homes. But excellent as is this project for reviewing otherwise wasted energies for the good both of the individual and the state, it presents various difficulties from a practical point of view. One of these is this greater liability to accident of a man possessing only part of his normal physical strength and alertness. It will be seen that a serious injustice to employers might occur if they were held equally responsible for the lives and limbs of such cripples as for men sound and whole. That this is already felt is shown by a law just promulgated in France by whose terms employers are not held liable for accidents while at labor occurring to workmen who have been mutilated in the war and due to such mutilation.

The indemnity allotted to such victims will be provided by a special fund formed by contributions levied upon all the employers without exception and to which those insured will furnish a quota. It is believed that this law will greatly facilitate the return of cripples to their former trades, or new ones for which they have been fitted by proper prothetic apparatus and suitable re-education.

A National Laboratory of Industry for France

WE recently announced in these pages, and warmly commended, the establishment of a National Laboratory for Industrial Research at Helsingfors, in the small, but progressive country of Finland. It gives us pleasure to state that this admirable idea has been adopted in France. At a recent session of the Academy of Sciences the following resolution, was unanimously adopted:

"The Academy of Sciences, convinced of the necessity of organizing in France, in a systematic manner, certain scientific researches, states its resolution of creating a National Laboratory of Physics and Mechanics charged charged with the office of pursuing scientific researches furthering the progress of industry. This Laboratory will be under the direction of the Academy of Sciences."

This important step will undoubtedly be fraught with many advantages for the industry and commerce of France. Besides the solving of various difficult practical problems there is certain to be an advance in the theoretic knowledge which sooner or later is transformed from potential power to the kinetic force of practical achievement. Moreover the benefits which thus accrue to the great industries of the country cannot fail to produce that ultimate psychological reaction which will so open the mind—and the pocket-book—of the man of affairs as to benefit in its turn the cause of pure science.

Electricity

Demand for Telephone in Japan.—It is estimated that there are some 150,000 persons and firms in Japan awaiting the installation of telephones on their premises. The government, which is in charge of the telephone system, is unable to keep pace with the demand for telephone service.

The Geissler Tube as a Cable Testing Device.—To determine when high-tension conductors are energized a public service company of Buffalo, N. Y., makes use of a cable tester which depends for its action on static charge and not direct contact. The device consists of a Geissler tube in series with a condenser. Both are attached to a wooden rod with a metal tip and are connected with a grounding clamp by a flexible cable. When the metallic tip is applied to the sheath of a high-tension cable which is energized the tube will glow brightly. A similar device, states the *Electrical World*, has been developed by a Rochester railway and light company.

Alternating Current Arc.—In a paper on the production of light by recombination of ions, published in the January issue of the *Physical Review*, the author, C. D. Child, brings out a number of interesting facts. The work of Fleming and Petavel on the intensity of the light from an alternating current carbon arc at different phases was repeated and a similar study was made of the flaming arc and mercury arc in a vacuum, states Mr. Child. In every case the intensity of the light passes through a minimum without entirely vanishing, and this minimum occurs after the current passes through the zero value. With the mercury arc the minimum intensity occurs approximately 1-1800 second after the current becomes zero. In this case the continuance of the light indicates that the light is due to the recombination of the positive and negative ions, since there is here no chance for oxidation or other known chemical action.

Magnet Industry in England.—The Sheffield *Daily Telegraph* states that Sheffield promises to become the center of the manufacture of magnets, which were obtained before the war almost exclusively from Germany. On the outbreak of hostilities only one or two firms in Great Britain had given any attention to this particular product, although Sheffield had been for a long period supplying the steel to makers in Germany and elsewhere abroad. The collapse of the German supply placed the British electrical trade in a serious difficulty and for some time matters looked ominous, especially in the magneto industry. Sheffield, however, is said to have saved the situation. A half dozen or more firms there have been producing magnets on a large scale and of satisfactory quality for a considerable time, and there is every reason to believe that when peace returns the British magnet industry will remain.

An Electrically Heated Mine Ambulance.—The *Colliery Guardian* gives an account of a useful form of ambulance being introduced in one of the mines in Wyoming. Formerly it was usual, when an accident occurred in the mine, to place the injured man on a stretcher, transporting him to the surface in a mine car. As the distance to be traveled might be from three to four miles and against the high velocity intake current of air, the injured men often became chilled and this retarded recovery. The difficulty has now been overcome by the use of a specially designed ambulance, which is electrically heated and lighted, and is equipped with a cot suspended on springs to obviate any jarring. The ambulance can accommodate both the patient and an attendant, and is equipped with receptacles on either side in which first-aid supplies, hot-water bottles, blankets, and other necessities can be stored.

A Curious Electromagnetic Phenomenon.—In *Metallurgical and Chemical Engineering* E. F. Northrup describes a curious effect noted in an electromagnet with a wire core. When subjected to a heavy alternating current the wires at the center of the core began to creep forward out of the solenoid until finally the extremity of the core instead of being flat became conical. By giving one of the wires a slight twist in one direction or the other the extended cone of wires could be made to form at either end of the solenoid. The core thus appeared to be in unstable equilibrium, the direction of motion being determined by a slight mechanical displacement. The effect can also be illustrated by making the core in two sections, a central iron rod in a surrounding iron cylinder. The central core is free to move, and on suddenly applying a direct current, jumps completely out of the solenoid and takes up a position in prolongation of the cylinder wall. The motion is quicker than the eye can follow. On the other hand, it is found that if the diameter of the movable core be nearly equal to the diameter of the immovable position the former tends to be sucked into the solenoid. By suitably proportioning the movable and immovable portions of the core a neutral condition could be obtained, the central portion being neither drawn in nor projected. A similar result could be obtained by increasing the magnetic permeability of the fixed core, as compared with that of the movable portion.

Science

Specimens of Pure Iron.—What is said to be probably the purest iron in existence is now prepared at the Bureau of Standards, in Washington, in the form of ingots about 6x2 inches. These ingots are not only used at the bureau itself, in connection with various investigations, but are also supplied to university and other scientific laboratories in this country and abroad.

Color-Blindness Tests.—At the request of the Navy Department the Bureau of Standards has undertaken to standardize the colors used in color-blindness tests. A number of persons have been tested for color blindness at the bureau itself, in connection with photometric observations on which they were engaged, and considerable time has been given to a study of the methods used in such testing.

The American Academy of Public Health was founded in Cincinnati last October. The membership is limited to persons actively engaged in public health work, and it is proposed to hold annual meetings, devoted to the discussion of reports made by special committees of the academy as a result of their work or investigation. It is hoped that the new organization will stimulate original work in public health science and raise the standards of public health practice.

Gravity Over the Indian Ocean.—In a paper read before the British Association, W. G. Duffield describes comparisons between the readings of a marine mercurial barometer and an aneroid barometer on voyages to and from Australia, and draws some tentative conclusions based on the fact that readings of a mercurial barometer are affected by gravity while those of an aneroid are not. The results point to a decrease of gravity over the deep Indian Ocean, contrary to the theory of isostasy.

Ratings of Gas-Mantle Lamps.—In coöperation with the American Gas Institute, the Bureau of Standards has been making an experimental study of the conditions which must be taken into account in the rating of gas lamps. This is a new undertaking, as ratings of gas lamps have not heretofore been standardized, as have the ratings of electric lamps. The investigations include measurements of the candle-power and efficiency over a wide range of gas consumption for several types of lamps at several different gas pressures. Measurements have also been made to compare the efficiencies obtained in burning natural gas with those given by manufactured gas, and to compare the results of using manufactured gas of various compositions, falling within legal requirements.

Illiteracy in the United States.—According to a bulletin on "Adult Illiteracy," just published by the Bureau of Education, five and a half million people in the United States over 10 years of age are illiterate, or nearly eight out of every hundred. Few people realize the extent of the problem of teaching merely the elements of reading and writing to the illiterates in the country who are beyond school age and of whom over a million can speak no English. The percentage of illiteracy in the southern States has been reduced one-half in the last two decades, but in the Middle Atlantic States—along the Atlantic seaboard—there has been but slight decrease in percentage, while there has been a large increase in numbers, "possible owing," says the bulletin, "to lack of realization on the part of the general public and educators of changed conditions due to new types of foreign immigration." It is rather startling to hear that in the state of Connecticut there has been an increase in illiteracy during the past decade, not only in number but also in percentage. Illiterates, as the term is used in this bulletin, are persons who have not learned to write in any language.

The Feeding Value of Wood.—Some suggestive experiments have been recently carried out in Germany by G. Haberlandt, partly under official auspices, on the possibility of utilizing wood as food for animals and man. The first experiments were made on a sheep, in a respiration chamber, for the purpose of determining the digestibility and nutritive value of birch wood. The trees were felled in the early spring, and the trunks, measuring 4 to 6 inches in diameter, were reduced to very small chips in a paper mill. Microscopic examination showed that the wood was very finely divided, so that the membranes of nearly all the cells were destroyed, while the cell contents had been almost all removed by the water used in the preparation of wood. Thus the residue consisted chiefly of cellular membrane. The wood was fed in combination with other foods. Good results were obtained, both as to digestibility and nutritive value. Apparently the reason why previous experiments on the same subject had not been successful was that the wood was not cut up fine enough and its cells were not thoroughly torn. The experiments were repeated by Prof. Rubner on a dog, the same wood ration being fed with meat, and the results were also successful. Haberlandt believes that man is capable of digesting finely ground birch wood, and that it might replace rye or wheat to the extent of 10 or 15 per cent in bread making.

Aeronautical

Flights of the U. S. Signal Corps.—From January 1st, 1916, to October 14th, 1916, there were 8,052 flights made by the Aviation Section of the U. S. Signal Corps, with a total time in the air of 3,700 hours and 6 minutes. This makes approximately a mileage of 333,000.

Aeroplanes at the Japanese Military Maneuvers held during the first half of last November, were much in evidence. One feature was the participation of 16 aeroplanes, eight being attached to the "invading" force and eight to the "defenders." A good deal of night flying was carried out. Four of the machines which took part flew from Tokorozawa to Fukuoka, a distance of about seven hundred miles.

Berlin Estimates of Allied Aerial Losses.—From the beginning of the war to January 31st, 1917, German battleplanes and anti-aircraft batteries destroyed 1,002 hostile machines, or 167 enemy squadrons of six machines each, according to official statistics obtained by the Overseas News Agency. In the period stated, 1,700 hostile aviators were put out of the combat and machines valued at 50,000,000 marks were destroyed. In 1914-1915 hostile aeroplanes to the number of 163 were brought down. In 1916 the Teutons brought to earth 734 hostile machines, and in January, 1917, the number of aeroplanes accounted for was 55.

Aeroplanes Now in Service in the United States.—There are over one hundred aeroplanes in flight service to-day, as compared with 12 a year ago. Five hundred will be in service, it is understood, at a relatively early date. There are 50 rated military aviators to-day; in addition to 50 officer-students at San Diego. There are 50 reserve corps aviators in various stages of advancement. About six hundred and fifty elementary licenses have been issued to aviators in this country since the beginning of the art. A goodly number of men to whom these licenses were issued are not now available for service. About seventy expert licenses have been issued.

American-Made Gnome Engine.—Under special arrangement with the owners of the Gnome engine patents, an American concern is now producing these famous rotary engines for the belligerents as well as for the United States Government. In every respect the domestic product compares favorably with the Gnome engines produced in France, which is a tribute to American manufacturing methods, since the parts must be worked to within 1-100mm. (4-10,000 inch) to get the necessary results. The American-made 100-horse-power Gnome engine is of the nine-cylinder, mono-soupape type. It is designed to operate at a normal speed of 1,200 to 1,250, and complete weighs 272 pounds. The gasoline consumption per hour is 12 gallons, and 2.4 gallons of lubricating oil.

How Aeroplanes Attack Railroads.—The following scheme, which was planned to intercept German traffic on the Douai-Lille main line, was recently carried out by the British airmen in France: "The railway station at Libercourt, sidings, and rolling stock were to be bombed, and an attempt made to attack trains going south, in the hope that they might be carrying troops or ammunition towards the Somme battlefield. Patrols, each of three aeroplanes, were first sent to attack neighboring enemy aerodromes to prevent German aeroplanes from going up to interfere; smoke bombs were dropped at intervals to keep the aerodromes enveloped in smoke, and from time to time a high explosive bomb to show that our machines were still there. During this period two of our machines were to descend and attack the trains. The first train to appear was seen leaving Libercourt at about 1.40 p. m., and our machines dived down to attack it. While descending a second train was seen coming up on a branch line towards Ostricourt, where it joins the main line, and one of our machines diverted on to it. The first train was attacked from a height of about 800 feet near Ostricourt; six bombs were dropped. The engine was hit, became derailed, and two or three of the front coaches partly telescoped. German soldiers immediately began to alight, were fired on, and ran towards Ostricourt village and woods. There were so many men that the pilots said it would have been hard to miss them, and a large number were either killed or wounded. Meanwhile, the second train came to a standstill near the junction, as the wrecked train on the main line was blocking its way. The other machine attacked it with six bombs, two of which hit the train and the engine. Troops also here began to descend, and were fired on. They fled towards the neighboring village. Altogether between 600 and 700 rounds were fired by the two aeroplanes, and many German soldiers were hit. Neither of our machines was fired on. As soon as the attack on the trains began the main raiding party, composed of seven aeroplanes, and an escort, attacked Libercourt Station at about 2 p. m., where 14 heavy and 34 smaller bombs were dropped. Station buildings, sidings and rolling stock were hit, some carriages were wrecked, and one coach was afterwards observed to be lying crossways over the line. The patrol over Brovin Aerodrome destroyed a hangar in the course of its work."

The Unarmored Battleship

Tendency is Toward High Speed, Great Gun Power and Large Displacement

By Commander Yates Stirling, Jr., U. S. Navy

UNTIL quite recently, the evolution of the battleship was based almost solely on the power of the gun, for the danger of the torpedo from a surface craft was being discounted. Battleships strove to carry sufficient thickness of armor to prevent shell penetration. Those nations who built their battleships with internal underwater armor reckoned only with a moderately heavy torpedo war head. That such underwater protection is wholly inadequate can be readily understood when it is remembered that a torpedo war head is now used which contains nearly five hundred pounds of the highest explosive known. This is nearly double what was used at the commencement of the war.

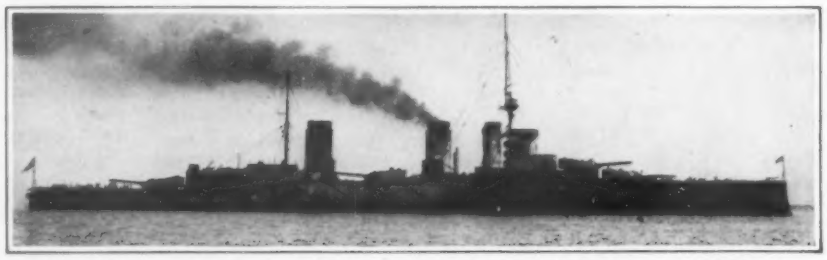
The present-day battleships or the super-dreadnoughts, as they are called, are fairly adequately protected from gun fire by their great weight of armor. The maximum speed of the battleships is but little greater than that of the latest submarines. A battleship requires probably more than half an hour to go from its cruising speed to its maximum, while a submarine can be going at its highest available surface speed within a few minutes. A submarine can sight a battleship at a distance of about 25,000 yards or 12½ miles. A battleship can recognize a submarine in the awash condition at no greater distance than 5,000 yards, or 2½ miles. A submarine, on sighting an enemy ship, would immediately sink to as near the water as possible, in order to avoid detection, for a submarine, when silhouetted against the sky, can be recognized a long distance away.

If the battleship's course heads through the tactical area of the submarine, there is almost the certainty of destruction involved for the big ship, unless it is accompanied by numerous anti-submarine craft.

The control of the surface of the sea is an important factor in the command of the sea. To control the surface, gun power, coupled with high speed, is essential. To gain high speed, retaining gun power at a maximum, armor must be sacrificed. The evolution of the dreadnought battleship of 21 knots speed was shaken to its foundation when the submarine reached its present state of offensive development. England and Germany both realized this short-coming in speed when they laid down, respectively, the "Queen Elizabeth" of 25 knots and the "Ersatz Kaiser Friedrich" of 23 knots. Although data is not available, armor protection was probably sacrificed for the added speed. Each nation aimed at the control of the surface.

The logical development of the *dreadnought* battleship is towards the maximum number of the largest caliber guns with the highest speed attainable on the displacement permitted by other circumstances. The *cruiser* development seems to be toward guns of larger caliber than that carried by a contemporary battleship and with higher speed for the purpose of outranging the battleship. The battleship probably will retain some armor, but when it finds itself outranged by its enemy and without the speed to force a closer action, it too must eventually sacrifice all armor for gun power and speed. Thus, the development of these two types, the dreadnought and battle-cruiser, appears to be toward an amalgamation.

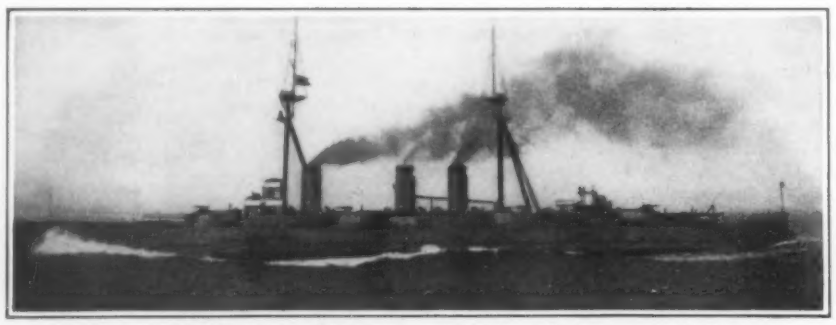
From the very nature of the problem of defense of our shores we require a type in which must be combined great gun power, large cruising radius and high speed. We should be able to hold possession of our own waters. It does not suffice for our fleet to meet an enemy on or near our coast line; we must meet him beyond in order that our peace lines of communication may remain unmolested. This principle holds for every type of warship.



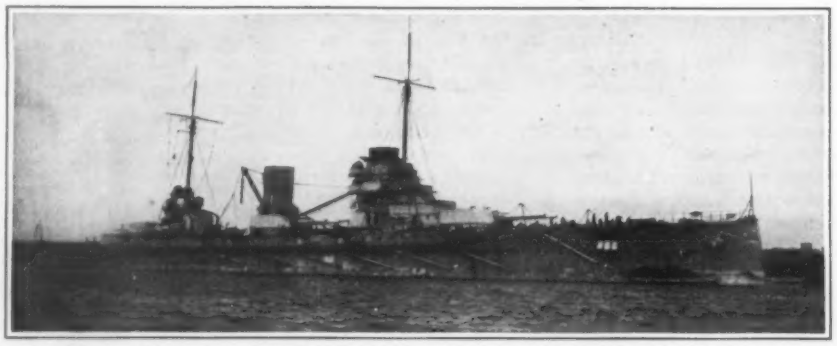
British Battle-cruiser "Queen Mary." Armor 9-inch. Displacement, 28,000 tons. Speed, 30 knots

	Gun Power	Armor	Speed	Length	Beam	Draft	Displacement
(1)	12-14 inch	13½ inches	21 K.	600 feet	97 feet	29 feet	32,000
(2)	12-14 inch	13½ inches	26 K.	895 feet	98 feet	31 feet	45,000
(3)	12-14 inch	13½ inches	29 K.	1,070 feet	100 feet	33 feet	59,500
(4)	12-14 inch	13½ inches	32 K.	1,250 feet	106 feet	36 feet	79,000
(5)	12-14 inch	13½ inches	35 K.	1,500 feet	114 feet	40 feet	102,000

Table No. 1. Maximum Armor



Japanese Battleship "Kawachi." Armor, 12-inch. Displacement 21,500 tons. Speed 21 knots



Turkish Battle-cruiser "Goeben." Armor, 11-inch. Displacement, 23,000 tons. Speed 28 knots

	Gun	Armor	Speed	Length	Beam	Draft	Displacement
(1)	12-14 inch	8 inches	26 K.	765 feet	88 feet	29 feet	30,750
(2)	12-14 inch	8 inches	29 K.	930 feet	89 feet	30 feet	39,500
(3)	12-14 inch	8 inches	32 K.	1,135 feet	93 feet	32 feet	53,500
(4)	12-14 inch	8 inches	35 K.	1,400 feet	100 feet	34 feet	80,000

Table No. 2. Safest Minimum

French Battleship "Jean Bart." Armor, 10 3-4 inch. Displacement, 23,500 tons. Speed, 22.5 knots

Barring England and Mexico, an attack upon the United States, in its initial stages, must be conducted in many vessels across many miles of sea. In the event of war, therefore, with an enemy across the sea, our first duty will be to gain touch with his attacking expedition as far from our coast as possible and convenient in order to harass and eventually annihilate it. Slow battleships seem to have no place in our "attacking" fleet. We should have types capable of "controlling the surface" from our shores to the advancing enemy. By this means we shall lessen, it not eliminate, the danger of enemy submarines, and give our own mobile offensive type of submarines an added value. Gun power, radius of action, and speed are essential for this work. These are the pivotal attributes. To gain them, all purely defensive attributes will have to be sacrificed.

Every nation must eventually reach a maximum limit of displacement, which it would be ruinous financially to go beyond. In our case this limit is for all times fixed by the size of the Panama Canal locks. These locks have the following dimensions:

Length	1,000 feet
Width	110 feet
Depth	40 feet

This most important passage, enabling us to concentrate a fleet in either ocean, can pass in safely a vessel with the following maximum dimensions:

Length	950 feet
Beam	100 feet
Draft	36 feet

"You cannot have anything for nothing," is a truth that the naval constructor and designer of warships never ceases to expound to the sea officers who seem to want thick armor, great gun power and high speed on a moderate displacement. There must be sacrifices. The least important must feel the knife.

If great speed is desired while retaining maximum gun power, radius of action and armor protection, we must send the displacement to illimitable heights. The figures in table No. 1 are authentic and sufficiently accurate.

If, on the other hand, we thin down the armor to what has been termed by naval architects the "Safest minimum," we have the figures given in Table No. 2.

From the figures in the tables a comparison of the two largest ships capable of passing through the Panama Canal would appear instructive.

With maximum armor we can build a vessel of 45,000 tons of 26 knots speed, with safest minimum armor one of 39,500 tons of 29 knots speed. Gun power has been taken as equal; that is each is armed with 12-14 inch guns. The two vessels having the same caliber of guns must fight at a range within the capabilities of that caliber. At the range which must be chosen the 8 inches of armor carried by the faster ship will not furnish adequate protection. It is, therefore, weight wasted, which should have been put into a larger caliber of gun to enable the faster and more lightly protected ship to outrange the slower.

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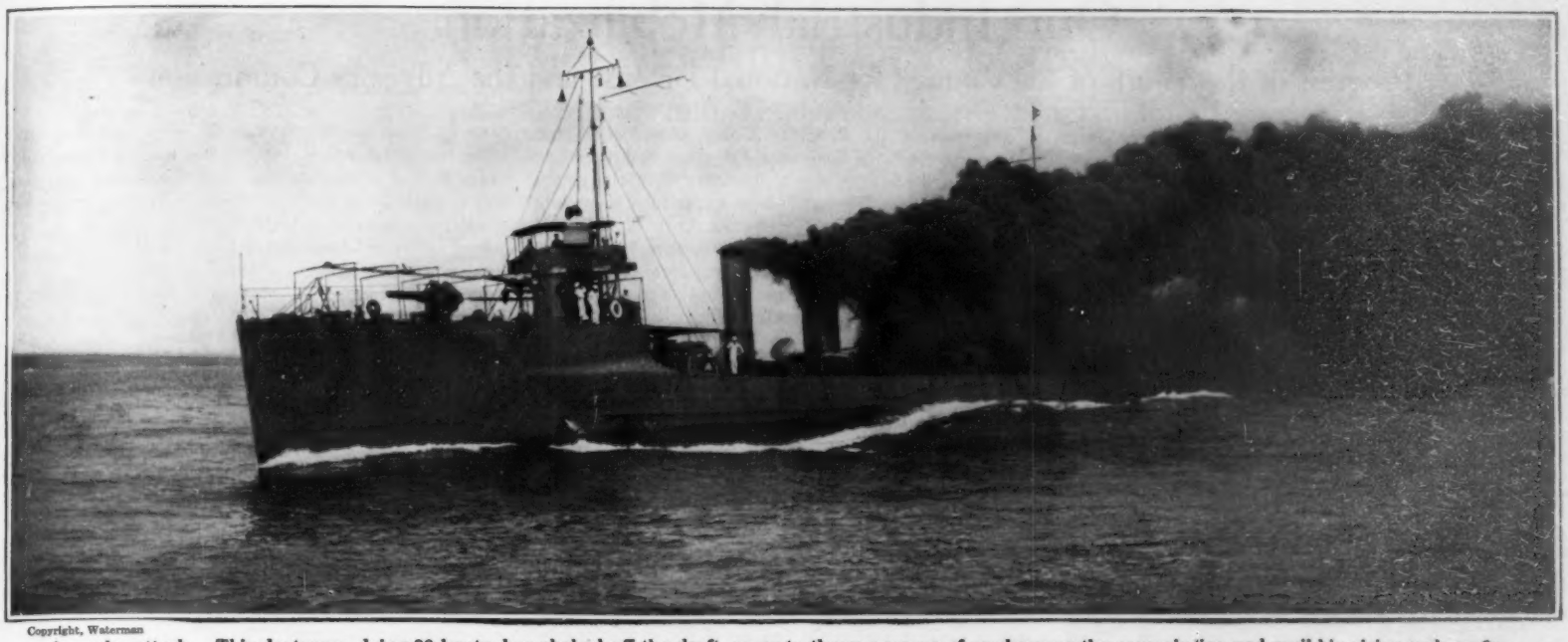

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A smoke attack. This destroyer, doing 30 knots, has choked off the draft, so as to throw a screen of smoke upon the enemy's line and spoil his vision and gunfire. This maneuver originated in this country and was frequently employed in the Jutland battle

The Destroyer and the Torpedo

High Speed and Quick Turning Ability the Effective Answer to the Torpedo

THE torpedo is not, in the military sense, nearly so important a weapon of offense as it is popularly supposed to be. We say "in a military sense"; for the enormous destruction of unarmed and helpless merchant shipping which the Germans have accomplished, is not a military operation, but mere outlawed piracy. If Germany had obeyed those humanitarian laws of war, which are the outgrowth of many centuries of endeavor to protect the non-combatant from the cruelties and losses of war, there would have been a comparatively small toll of sunken ships to their credit.

All through the history of the development of torpedo warfare, the inventors, in their plans and specifications have shown that they were trying to devise some means of sinking warships, unseen by the enemy. Bushnell, Fulton and Holland in this country, to say nothing of the French and Italian inventors, carried in their minds as the object of attack only the warship. The merchant ship, they well knew, was recognized, in the universal opinion of civilized nations, as exempt from torpedo attack.

To Germany belongs, and will forever belong, the distinction of being the first naval power to break away from those safeguards of human life which have the sanction of centuries behind them, and divert the torpedo from its legitimate work as a weapon of war, and use it as an instrument for the wholesale murder of passengers and sailors upon the high seas.

So having now disabused our minds of any undue appreciation of the torpedo, drawn from its misue against helpless and unarmed ships, we shall be prepared to recognize the surprising fact that against swift and well-guarded warships, the torpedo has shown itself, in the present war, to be a surprisingly ineffectual weapon. Thus, in the battle off the mouth of the Elbe, lasting several hours, in which some fifty to sixty ships, all heavily armed with torpedoes and using them very freely, were engaged, not a single torpedo hit, if we remember rightly, was reported on either side. Even more significant is it that in the great battle of Jutland, in which over one hundred and twenty ships were engaged, and the destroyer flotillas were exceedingly active, only one torpedo hit was made on the whole of the British fleet, which must have included at least seventy to eighty vessels of every type. The battleship "Marlborough" was struck near the stern and listed rather heavily; but she was able to bring herself back to a level keel and continue the fight.

High speed and quick turning power have proved to be the best defense against the torpedo. The fast battle-cruisers and scouts are well able to take care of themselves, and the slower battleships are protected by numerous screens of destroyers, each flotilla being led by a fast light cruiser, carrying heavy torpedo defense guns, of from 4- to 6-inch caliber.

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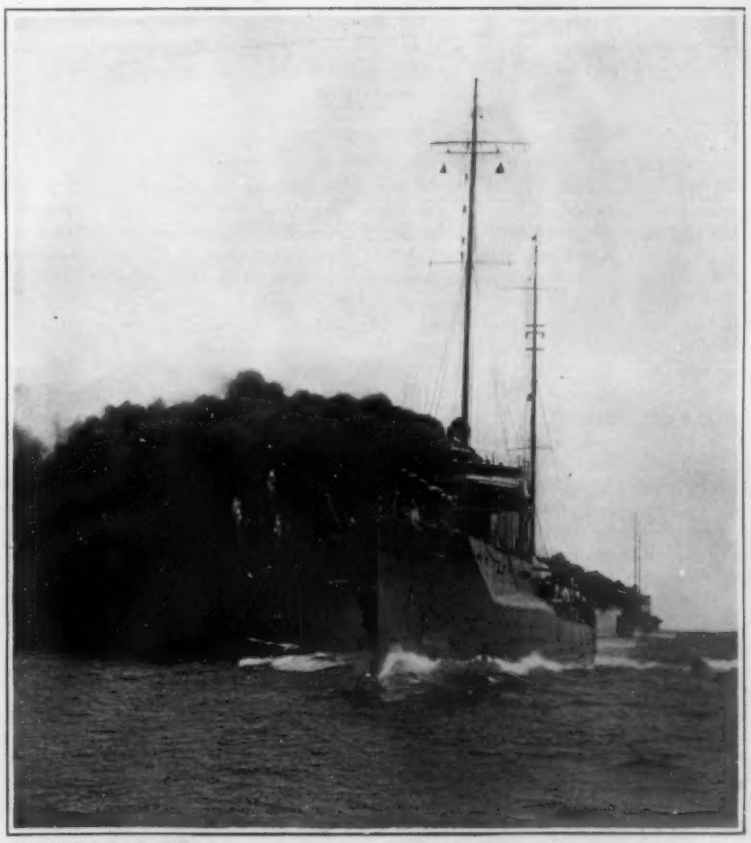
Practice with a rapid-fire gun on the after deck of a destroyer



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A group of 31-knot destroyers making a smoke screen which completely conceals them from the enemy

The failure of the torpedo to get in very much effective work aganist naval vessels is not due to the inefficiency of the torpedo itself; for the torpedo is indeed a wonderfully efficient weapon. It is stated that our latest 21-inch superheat torpedo will travel with marvelous accuracy for 10,000 yards at a speed of between thirty and forty knots. Target practice with these weapons, in time of peace, has proved that it will do this consistently; but target practice conditions, when the target is stationery or moving at a comparatively slow speed, and conditions in a sea fight, when the enemy's ships are moving at from twenty to thirty-five knots, are two very different propositions.

The failure of the torpedo against warships is not due to the weapon, but to the human element—the great difficulty of estimating the distance, speed and course of the enemy's ship. This is so far recognized in battleship tactics, that no attempt is made to fire the underwater torpedo tube of a battleship against the individual battleships of the enemy's column. The torpedoes, should the two fleets come within torpedo range, say 10,000 yards or less, would be discharged against the enemy's line as a whole, on the chance that while many of the torpedoes would pass between the ships, others would score a hit. The modern warship is about 200 yards long and the interval between the ships is about 500 yards, if they are keeping proper station, so that theoretically two out of seven torpedoes should hit the mark.

It is extremely difficult to hit a fast ship at a distance of 5,000 to 10,000 yards. Thus, a 700-foot battle-cruiser going 30 knots will cover a distance equal to her own length in 14 seconds, whereas it will take a torpedo of the latest design at least eight minutes to reach a ship 10,000 yards away. Now a 30-knot ship, moves at the rate of 50 feet per second, and hence it is necessary for the torpedo officer to estimate very closely the distance of the ship and the speed at which she is traveling, before he can determine how far ahead of the position of the ship he must aim his torpedo if ship and torpedo are to meet some minutes later. If he estimates the ship is traveling 30 knots, when she is traveling only 25, and cal-

(Concluded on page 244)

Our Industrial Mobilization

Progress of the Work of the Council for National Defense and the Advisory Commission

OUR readers are doubtless familiar, from the daily papers, with the formation, by Act of Congress, of the Council of National Defense and its Advisory Commission of seven men prominent in the various fields over which the Council is to operate. It may, however, be news to many of them that this council has taken over the work being done and the vast mass of industrial statistics gathered by the Industrial Preparedness Committee of the Naval Consulting Board, replacing the latter entirely as the organ for mobilization of our resources. From its new offices in Washington the Council is carrying on and extending in all directions the work of the Board. Much has been done of which no possible account can yet be given; but we have collated from semi-official and official sources as complete a statement of the present condition of the Council's labors as is at this moment possible.

An important development in the labors of the Council and the Advisory Commission took place at a recent joint meeting of Council and Commission in the office of Secretary of War Baker. Seven working sub-committees were formed, each having as its chairman one of the seven members of the Advisory Commission. These sub-committees are to have full charge of the investigations of their respective subjects, and to expedite the development of the industrial resources of the country for preparedness.

"Industrial resources" is an inclusive term. As used here it means not only plants, mines, factories, etc., but transportation and man-power, with special reference to the creation of an industrial reserve of trained workers, including of course, the professional talent, inventive genius and scientific knowledge of the United States.

The seven sub-committees with their chairmen are as follows:

(a) Medicine, including general sanitation, Dr. F. H. Martin.

(b) Labor, including the conservation of health and welfare of workers, Samuel Gompers.

(c) Transportation and communication, Daniel Willard.

(d) Science and Research, including engineering and education, Dr. Hollis Godfrey.

(e) Raw materials, minerals and metals, Bernard M. Baruch.

(f) Munition manufacturing, including standardizing and industrial relations, Mr. Howard Coffin.

(g) Supplies, including food and clothing, Mr. Julius Rosenwald.

The several chairmen have planned to hold a series of conferences with representatives of various businesses, trades and professions and to ask them to organize so that they may deal with the council through one man or a committee of not more than three men. Where possible such conferences will be held with the representative trade or professional body representing the industry or profession under consideration, in order to expedite the work of gathering statistical knowledge and to eliminate that red tape and delay which is an inevitable consequence of the attempt to deal with large bodies of men of scattered trades or professions.

Under the present organization of the Advisory Commission Dr. Hollis Godfrey is chairman of the whole. He has, however, signified his intention of retiring from these labors on March 1st, the date marking the end of the period for which he accepted service. There is a strong effort on the part of all the members of the committee to persuade Mr. Willard, President of the Baltimore and Ohio Railroad, to take the chairmanship which Dr. Godfrey desires to leave vacant, although all hopes have not yet been abandoned of persuading Dr. Godfrey to remain.

Under the present organization the Advisory Commission of the National Council of Defence is under supervision of a director, Mr. W. S. Gifford, who has been "loaned" to the Government by the American Bell Telephone Company. So quietly has Mr. Gifford done the enormous amount of work which has been accomplished by the Advisory Committee that few know how it is regarded by those in authority. But a recent action of the National Chamber of Commerce shows how the thinking business man regards preparedness. The Chamber of Commerce of the United States passed resolutions promising unlimited coöperation with the Council of National Defense, and strongly suggesting that the Director of the Advisory Commission be given a legal equality with the Chief of Staff of the Army and the Chief of Operations of the Navy. Incidentally the Chamber of Commerce went on record against excessive profits in the suppyling of material to the United States Government in time of war, affirming its belief that all such manufacturing should be done at cost plus a reasonable profit.

Attention of the Advisory Commission, which has held daily meetings beginning February 12th, is being focussed upon finding the need, rather than the means of satisfying it. No man whose experience gives him definite knowledge of the resources, both of men and industry, which the United States possesses, but realizes that the country can eventually take care of any need which may arise. Preparedness is not so much a question of filling a want as determining just what the "want" may be, so that the resource to satisfy it may be brought instantly in touch when necessity arises. Thus, there are perhaps a hundred large automobile factories in operation in the country, the resources of which would be instantly at the service of the country if necessary. That fact, however, promises nothing to the military authorities. What they need to know is what each of these many factories could really do, and what need of the Army or Navy they could supply? Obviously a factory engaged in turning out automobile motors or heavy trucks and one manufacturing storage batteries or speedometers would not be able to turn their machinery to the same work in supplying munitions. To decide *what* is needed, and *which* industrial plants can *best* be considered for supplying the need is among the most important questions now being considered by the Advisory Commission.

In this connection the experience of England is being studied from every possible angle. Naturally, very little of this phase of the work is being made public. The problem which the United States is facing now, in advance of the emergency, is very largely that which David Lloyd George faced when he took hold of the enormous task of mobilizing England's industrial resources—using the words in the same broad sense—to back up and make effective her suddenly created army. Reports of what he has done and the way he has done it have been exhaustively studied and every occasion is taken to get as many side lights upon the foreign situation as is possible. When Mr. Herbert Hoover, of Belgian fame, came recently to Washington, he was asked to tell the Advisory Committee all he could of industrial mobilization abroad and the way it had been accomplished. Unquestionably, too, although no member of the Commission will say so, business affiliations between American and Canadian industries are being utilized to bring to the States the experience of the Canadian manufacturers.

Wherever possible, practical steps have been taken to utilize existing organizations in various lines, looking to immediate coöperation with the Government in time of need. For instance, the Executive Committee of the American Railway Association has taken over the task originally given Mr. Willard when he accepted the chairmanship of the Committee on Transportation and Communication. Four sub-committees have been named by the American Railway Association, one for each of our four military departments. Headquarters will be maintained by these committees adjacent to the headquarters of the military department with which they will work, thus keeping railroad chiefs in immediate touch with military commanders.

Over 280,000 miles of railroad are thus organized as an auxiliary to the Army. The general chairman of the new Special Committee of the American Railway Association on National Defense is Mr. Fairfax Harrison, President of the Southern Railway. The Chairmen of sub-committees for the Eastern Department is Mr. L. F. Loree, President of the Delaware and Hudson; Chairman for the Central Department, Mr. R. H. Ashton, President of the Chicago and Northwestern; Chairman of the Southern Department, Mr. W. B. Scott, President Southern Pacific Lines in Texas and Louisiana; and Chairman for the Western Department, Mr. William Sprouls, President of the Southern Pacific Company.

Readers familiar with the acts of Congress authorizing the Council of National Defense will recall that two highly important provisions were for the creation of the industrial reserve and the "minimum annual order" by which the United States Government may order material for military purposes without competitive bids, in such quantities as will serve to educate plant and factories in the production of such goods.

As yet, the "minimum annual order" system has not been put into effect. The delay, however, has been necessary. Before such educational orders are placed it is vitally necessary that the Advisory Commission know just where to place them and just what to place them for. For this reason, among others, the work of inventorying the United States as to its manufacturing and industrial resources has been vigorously pushed with the result that more than twenty-seven thousand plants of all possible character have been catalogued with exhaustive data as to the possibilities which each presents.

In addition to being the preliminary work necessary alike for mobilization, for the beginning of the minimum annual order campaign and for record purposes, this statistical summary provides the working basis from which to create the industrial reserve. In war as now waged industrial force has become as important as the fighting army. Skilled mechanics in all lines of production must be kept from enlistment and be retained in factories, mills and mines for the production of munitions. It is essential, that the names of these skilled workmen be listed and the men be enrolled in the Industrial Reserve. It is proposed that in the event of war a button or other distinguishing mark be supplied by the Government to skilled workmen enrolled in the Industrial Reserve, and such enrollment will carry with it honors equal to enrollment in the fighting army. It is also proposed that a Government card be issued to each man enlisted. Plans are already formulated for carrying out this work, but at present they are withheld from publication.

A very encouraging feature of the "Preparedness Census" has been the more than ready response of the American manufacturer. The newspapers gave a great deal of space to Mr. Ford's offer to supply three thousand motors or one thousand one-man submarines a day at cost. This proposal has been only one of thousands, not only from manufacturers at present making munitions or material used by army or navy, but from organizations making goods for peaceful use only. Many such realize, in advance of the decision of the Advisory Commission, how easily their plants could be quickly reorganized for other purposes than those for which erected. For instance, a sash-chain maker offered to produce cartridge clips for rifles and machine guns; a manufacturer of threshing machinery proposed to make 600 six-inch shells per day; a maker of underwear proposed to turn out bandages and other knit goods; a button maker presented himself as a willing candidate for a munitions job, and a company manufacturing drugs stated that it could turn a considerable portion of its product into an adjunct for making cordite for shells.

A foundry man said he was well equipped to turn out tools and machinery for small arms and ammunition; a maker of belting suggested that he could produce webbing with which to fasten equipment on soldiers, and a condensed milk manufacturer thought he could be of use to his government in time of war in preparing canned food.

Such instances might be multiplied indefinitely. From the Commission's point of view, offers to turn a plant upside down and remake it to order are less important than the willingness to reply to the searching and exhaustive questions asked in the preparedness inventory. With exceptions too few to note, no industrial plant of any appreciable size in the country but has willingly, even gladly, given all the information asked for, and in the majority of cases adding an offer to do anything, without thought of business or profit, to aid the Advisory Commission in perfecting its plans.

This enthusiastic coöperation has come not only from manufacturers and developers of natural resources but from laboratories of science, seats of learning, and the hospitals. The Committee having medical matters in charge has made especially noteworthy progress, and is now calling in conference manufacturers of medical, surgical and hospital supplies, with a view to standardizing needed material for war use. Over 20,000 doctors have been classified as to the work they do best and listed as possibilities for the Officers' Reserve Corps. All civilian hospitals have been listed, and comprehensive statistics of their resources and capacities placed on file. It is hardly necessary to point out that such information will unquestionably be of immense service in any emergency, whether it be war, flood, famine, pestilence, or such catastrophies as Johnstown, Galveston, Mississippi River overflow, and the like.

Perhaps nothing which the Council of National Defense has done—at least nothing which it has thought advisable to make public—is of greater importance than this arousing of the industrial and professional talent of the nation to a spirit of coöperation. There has never been any question of our almost unlimited capacity. Our preparedness problem is almost wholly one of bringing together the need and the means to fill it, of eliminating loss of time, and of welding our resources into a coherent, smoothly working unit.

Its solution is probably much further advanced then the Council of National Defense or the Advisory Commission is willing to make public at this time, but sufficient information is available to show all who value true preparedness for its peace as well as war advantages, that if the United States knew it was never to enter any war, the work which has been done by the Council and the information it has gathered has been and will be of incalculable value.

The Machinery of Ships

Some of the Improvements and Tendencies in the Shipbuilding Industry

By Lieutenant-Commander H. C. Dinger, U. S. N.

THE new large building program for the Navy and the rehabilitation of the shipbuilding industry in this country has brought forth several new and interesting propositions for the machinery installations. This is a particular time for development.

The following new devices are being utilized, each in its most adaptable field.

Turbine reductions gears, etc.

Turbine electric drive installation.

Turbo-electric cruising units in connection with turbine reduction gears.

Oil burning express boilers, in very large units and embodying improvement in baffling and water circulation.

Superheaters in connection with express boilers.

Oil engines, the semi-Diesel for small powers and the Diesel for moderate powers.

New Problems

The European war and the great activity of the torpedo has indicated the need for special underwater protection on capital vessels and the need for isolating different parts of the machinery installation so that a damage to one part will not affect others. This has called for machinery layouts much more thoroughly protected than those that have gone before.

The *call for speed* has also been specially emphasized by the influences of the war. This demand for speed is very insistent and with it appears the rather difficult requirement that it must be produced without sacrifice of the defensive and offensive qualities of the vessel and that the cost must be within reasonable limits.

There are several methods of obtaining the extra speed required. One is to enlarge the displacement and thereby increase the cost. The other is to improve the fuel economy so that the weight of fuel to be carried for a certain radius will be decreased and so that the required boiler capacity can be reduced.

Another is to make changes in design that will enable the machinery to be more compact and lighter. Lightness can to a considerable extent be secured by utilization of better and stronger material.

More power on less total weight can be secured by:

(1) Improvement in fuel economy, this improvement to be considered and applied in the design and construction of all parts.

(2) A better and more appropriate design of all the component parts so that each is large enough but not of greater capacity than required to fulfil its function with relation to all the other parts. To secure this ideal balance is the aim of the expert designers, its success is depended upon exact knowledge of performances of engineering devices and the strength and properties of engineering material.

Each unit weight or unit surface, volume or space that is utilized in the machinery installation should give ideal capacity required by the design and do this with the greatest degree of efficiency.

(3) Reducing weight of machinery by use of better material and by constructional devices that tend to lightness without sacrifice of strength and durability.

The effect of progress along the lines of better economy and more expert proportions may be seen in the 35-knot destroyer design. This design for 35 knots, 26,000 S. H. P. requires about the same total weight of machinery and fuel that the previous 31-knot design required. The extra power is secured not merely by adding to the machinery but by putting in more economical machinery and a better proportioning of the various parts.

Turbo Reduction Gears

This type of machinery is being used for all up-to-date destroyers and scout vessels, and for capital ships where the electric drive is not employed. It is also used for passenger vessels, freighters and tramp steamers. It will undoubtedly be the future machinery for high-powered vessels, and will practically supersede the directly connected turbine and reciprocating steam engine.

For commercial vessels of small and moderate powers up to 5,000 S. H. P. it will compete with the oil engine, and in this field the oil engine will probably prevail, provided an oil supply at reasonable cost is at hand.

The turbine reduction gear is suitable for low-powered vessels as well as for the highest powers. It will save considerable weight as compared with directly connected turbines or reciprocating engines and is about ten per cent more economical than the directly connected turbine or steam engine.

Electric Drive

For large naval vessels the electric drive enables a sub-division and isolation of parts of machinery to be made.

It is in this particular that the electric drive has special advantages. The motors, the generators, the boilers, the piping can be isolated from each other and placed in separate compartments that are but slightly interconnected and in this way a much safer machinery installation is secured.

While the actual installations of the electric drive being made in this country do not obtain any better economy at full power than reduction gear installations would accomplish, it is expected that at cruising speeds the electric drive will show better economy.

There are, however, possibilities of securing much better economy in electric drive installations by utilizing the Ljungstrom turbo-generator which has been developed in Sweden and which secures about ten per cent better economy than other turbo-generators so far used. It is not unlikely that the manufacture of the Ljungstrom apparatus will be undertaken in this country in the near future. The electric drive canbe used in connection with Diesel driven generators as well as with steam driven generators. This matter will be discussed under the heading of oil engines.

Thus far the electric drive has not been applied to large merchant vessels and is not likely to be. For a commercial vessel the flexibility of the electric drive is not essential nor is its increased economy at lower powers of material advantage. It will probably cost more and weigh more than the turbine reduction gear machinery and at full speed secures no better economy.

The electric drive has certain military advantages that are of great practical value, and on these, flexibility, isolation of parts, ability to overhaul parts, economy at lower ranges and superior maneuvering qualities the reasons for its installation in capital vessels rest.

Better Boilers

The application of superheaters to express boilers and the development of oil burning boilers has also drawn attention to further improvements that can be made in boiler efficiency by securing better circulation of the water and a more efficient baffling and circulation of the gases of combustion. There are indications that an efficient adaptation of the counter flow principle and the matter of maintaining proper gas path and more uniform velocity of gases will add materially to the efficiency of boilers.

We now secure about eighty per cent efficiency on oil fuel boilers, but 90 per cent is within the realms of practicability.

Designs of boiler aiming to secure some of this better efficiency are being put forth and are under construction. Some development and experimental work is necessary, but the possibilities of improvement are there.

Superheat

Superheat has been used in a more or less haphazard fashion in marine installations. There has, however, been continual progress in it. The full practical advantages due to the use of superheat have not been realized. Superheat is especially advantageous on oil fuel boilers. Superheaters have not caused trouble and do not require special knowledge for their operation.

Superheaters are now being installed on shell and express boilers both in the United States and abroad, and a wide extension of their use may be looked for.

With high-speed turbines such as are used in connection with the turbo-generators for the electric drive and with the turbo-reduction gears a higher steam temperature can be carried safely. Heretofore, the steam temperature for marine work has been limited to about 500 degrees F. It is believed that a temperature up to 600 degrees F. can be employed. Such temperatures are used on shore and may as well be utilized at sea.

As yet superheaters have not been extensively employed on destroyer boilers, but a much more extended use can be looked for in the near future. Superheaters are being used in increasing numbers on new vessels fitted with reciprocating engines or with a combination of reciprocating engines with L. P. turbines.

Oil Engines

Oil engines are, of course, the engines to be utilized for submarines, for which service the high-speed, 4-cycle Diesel engine is particularly well adapted. There has been a special advance in the art of building Diesel engines in this country.

There is a marked development of Diesel engine installation for moderate powered freighters and also for tugs, fishing vessels and yachts. There are probably more marine Diesel engines under construction in this country than in any European country and as good engines as any abroad can be built here.

For naval work the Diesel engine will have a fruitful field, as the motive power for auxiliary vessels such as fuel ships, tenders, supply ships and this type of installation is also highly desirable for small cruisers and gunboats.

The advantage of the oil engine is its increased economy. The oil engine will require less than half the oil fuel required by a corresponding steam plant. For moderate powers the space and weight required (considering machinery and fuel together) are about the same as for a steam plant. The oil engine plant also will require less personnel for its operation, but the operating personnel must be more expert and specially trained. The oil engine installation also will cost somewhat more (about 25%) than the steam plant.

Oil engines are beyond the experimental stage and reliable engines are supplied by numerous firms, and during the next few years a large increase in use of oil engines for marine work may be looked for. For large high powered vessels the Diesel engine installation is too heavy and requires too much space as compared with steam turbine reduction gears, or with turbo-generator electric drive. The Diesel engine is, however, well adapted for use in connection with electric drive installation. By having some of the generators driven by Diesel engines their advantage in economy at cruising speeds can be fully realized. Designs contemplating such arrangements are being considered by manu-

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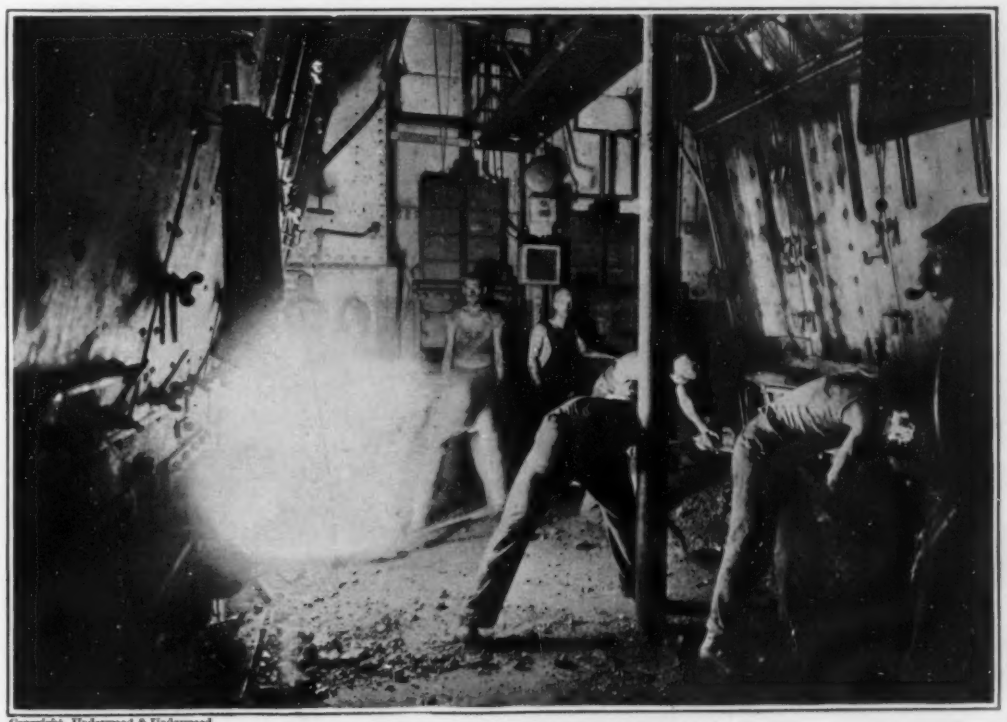
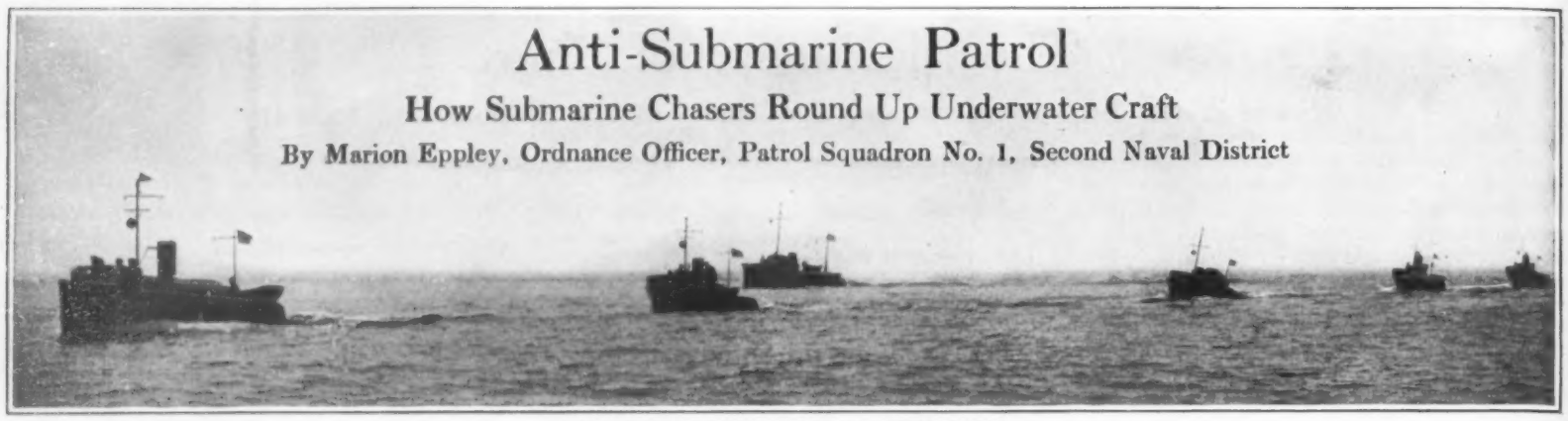


In the stokehold of the U. S. S. "Mississippi"

Anti-Submarine Patrol

How Submarine Chasers Round Up Underwater Craft

By Marion Eppley, Ordnance Officer, Patrol Squadron No. 1, Second Naval District



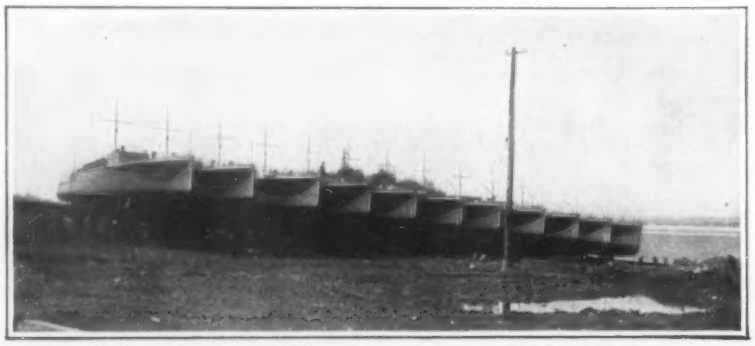
PATROLS MANUEVERING INTO POSITION

The smaller craft form a line abreast, while the larger boat follows on in the rear to intercept a submarine that dives under the advance screen.

WARFARE is a pitting of agencies of attack against methods of defense. In the contest the offense agencies provide the stimuli to which the defensive measures respond, so that a weapon is either balanced by the specific means operating against it, or is temporarily superior to them. An ineffective weapon seldom brings into being a specialized method of defense until it is sufficiently perfected to have marked military power. Underwater craft are not a new idea. Robert Fulton produced a workable submarine during the first part of the last century; and he was not the first, for another American made a one-man boat during our Revolutionary War. But these early types had no effect upon naval tactics, since they had negligible military power; it was not until the present war that defensive operations directed specifically at the U-boat had to be undertaken.

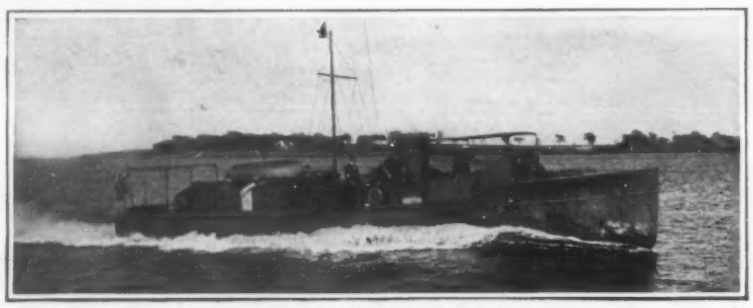
Before considering the ways of combatting "undercraft," analyze the characteristics of this class of sea-fighters. The primary quality indicating their use is their ability to conceal themselves quickly beneath the surface. Their security lies almost entirely in the power to submerge, and rise at some distant point. Hence the element of their tactics is surprise. But to see what is happening on the surface, the periscope must rise above the crest-level of the waves. One authority states that when the periscope is 20 feet above the water, a large battleship can be seen nearly six miles off, in clear weather. This would be a very satisfactory performance, without doubt. The same authority gives the limit of vision with the periscope one foot out of the water as about two thousand two hundred yards. But when a submarine is moving, the periscope causes a wave that looks like a white line on the surface, so that attention is called to it at once in calm weather. In rough weather, the periscope must emerge relatively higher so as to clear the wave-crests; this acts as a sort of mutually compensating protection as far as attacker and attacked are concerned. Since the driving-machinery causes a noticeable jarring, the periscope-tube is in constant vibration, making objects in the field far from distinct. Officers in our submarine service have said that about all they could see of our "chasers" was the bow-wave, unless the chaser was almost on top of them; in rough weather it was almost impossible to distinguish the bow-wave from a white-cap.

When totally submerged and running by indication of the gyro-compass, nothing can be seen but a greenish glow. (Some commanders claim that they can tell the approximate depth by the intensity of this color.) But as far as what is going on above is concerned, the boat is blind; and deaf as well, but for a microphone. This is an instrument that, by electrical means, magnifies sound waves travelling through the water and converts them into localized sound waves in the air; localized by a telephone receiver. By means of the microphone, the noise of a surface propeller can usually be picked up, as well as submarine-bell signals, and their direction determined with varying degrees of certainty.



A fleet of submarine chasers on the ways, ready for launching

A 3-pound semi-automatic Hotchkiss gun in use on an American chaser

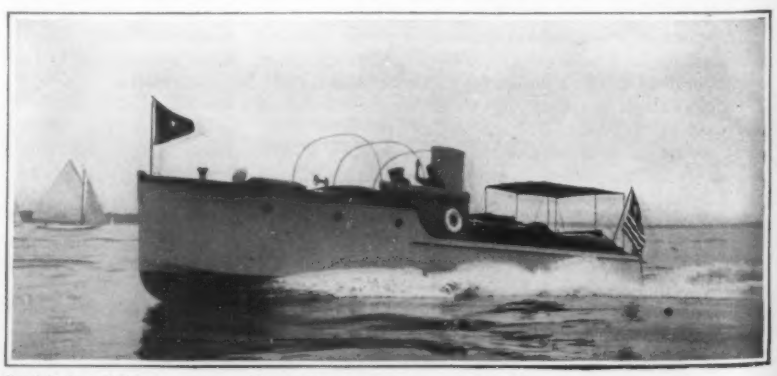


A type suitable for patrol duty

The destructive equipment of an undersea boat is provided by torpedoes and deck-guns. The torpedo is the only weapon available for use when submerged. Highly perfect though this missile is, it has serious limitations. It is bulky and heavy, so that only a limited supply can be carried; say from six to twenty at the very extreme limit. It is not always sure in its run, behaving in unaccountable ways without warning. It is of almost negligible effect against small craft, since it leaves a white streak in the water to warn of its approach. A small easily-handled vessel can dodge a torpedo seven times out of ten, if not oftener. It is reported that the torpedoes used by the German navy are set to run at a depth of nine feet, and that this adjustment cannot be changed. Therefore a boat drawing but four feet of water is immune from torpedo attack.

The customary deck-gun has been of approximately 3-inch caliber, but short in length for ease of stowage and handling. A gun of short length and reasonably large caliber has of necessity a low muzzle-velocity, say 1,500 foot-seconds. The U-53 is reported to have mounted 4-inch guns; that these were of low muzzle-velocity is indicated by her inability to sink one of the ships she attacked by gun-fire, even within short torpedo range. (Low muzzle-velocity causes a high trajectory, making it necessary to know the range with great accuracy, if hits are to be scored.) Sometimes deck-guns are mounted to swing into wells in the deck, covered with water-tight doors; sometimes they are set in a fixed position ready to be fired. In the latter instance, gun and action are made of a steel-alloy so high in nickel as to be resistant to the corrosion of sea-water. But so far as is now known, these batteries must always be served from the deck, so that the submarine must emerge, open its hatches, send up the gun-crews, and attach sight-tubes to the guns, carry out ammunition, and get into action. During the interval between rising above the surface and directing fire upon an enemy, a subsurface craft is at the mercy of any boat armed with a gun, if the gun is within effective range. This is doubly the case, since a submarine cannot carry heavy protective-armor on its exposed structure, because of the prohibitive weight. Water-ballast and fuel-oil tanks are so disposed as to afford protection, as well as to serve the ends for which they are designed, but a superposed layer of water is primarily intended to ward off projectiles. Hence, when operating against swift armed vessels of slight draft, even the largest underboat is at a

A swift scout, useful for harbor work



U. S. Navy type of scout patrol

disadvantage—she can't torpedo her plaguers and she runs a terrible risk in coming to the surface to engage in a gun duel. There is nothing to do but to sink out of sight and seek safety in submerged flight, or to lie still upon the bottom, if the depth permits.

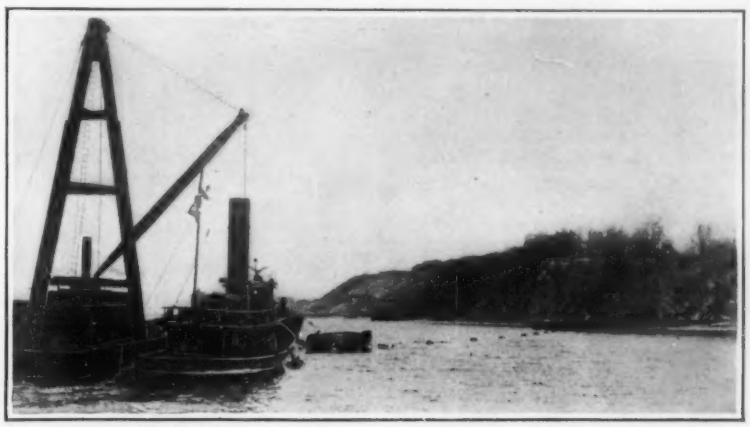
But these two expedients give only temporary relief. If the commander elects to seek safety in flight beneath the projecting element, he can travel for only ten or twelve hours, covering about one hundred and fifty miles. At the end of this period his batteries are entirely run down and must be recharged. To do this, he must rise to the surface and couple his surface-driving engines to the dynamo that supplies the charging current. Free ventilation is necessary to permit the battery-gases to be scavenged. On the other hand, if safety is found upon the bottom, the air-tanks must be pumped up before sixty hours have elapsed. This means rising to the surface and running the risk of disclosing the submarine's position through the noise made by the pumping-process. Both these operations make an undercraft peculiarly vulnerable. For this reason, frequent emergences are usual, in order to take advantage of a "clear coast" by running on the surface; the commander preferring to take the risk of a chance contact with a patrol rather than to exhaust his batteries or air-tanks.

There are two main methods of attack that a submarine can use. The first is to lie in wait upon the surface, and to pursue the objective vessel, destroying it by gun-fire. This presupposes that the sea is clear of enemy war-craft, and is the method that any surface craft would use. It is purely incidental to the intrinsic character of the submersible. To the other way of attack, the ability to travel submerged is essential. The submarine-commander awaits his prey in a partially submerged—"half light"—condition, or cruises slowly with only his periscope out. If submerged, he must keep some headway on his boat, maintaining depth by an inclination of his horizontal rudders contrary to the buoyancy—only a small reserve—of his vessel. Over here, we speak of "positive" and "negative" buoyancy, or "positive" and "negative," for short. When a boat has "positive," her buoyancy has been destroyed only partially by filling her ballast-tanks to less than capacity, and she tends to rise. When "negative" is possessed, all her boyancy has been annulled, and unless she is given an upward thrust by driving her forward with upwardly-inclined horizontal rudders, she sinks.

If the commander is conning his ship, he is at one of the periscopes—two are usual. In his field of vision he sees a steamer; this he lines up against two intersecting scales, one vertical and the other horizontal, projected upon the eye-piece of the instrument. These scales give him a means of judging approximately the distance and speed of his prey. The speed he can also gage by the bow-wave; to make this difficult, the British have often painted bow-waves on slow vessels, giving them the appearance of moving at high speed! A divided circle in the horizontal plane, to which the optical axis of the periscope is perpendicular, enables him to determine the bearing of the approaching ship. The steamer's course can also be determined very roughly and inaccurately by the two scales.

The submarine then dives, and totally out of sight, runs blind on a course determined by the above data, steering by gyro-compass. After what he considers a proper interval, the commander "porpoises," bringing his periscope out of water for a short period, submerging again as soon as possible, checks up his course, changes it if necessary, and runs on another dive by gyro. This procedure is repeated until he arrives within sure torpedo range, say one thousand yards, when he aims the missile, by aiming the whole boat, and fires. He may then wait to see that the torpedo is running true, or even until it strikes, or may sink out of sight at once. All this, of course, implies that he has not been seen, or that he is much speedier than his victim. If the prey sights the attacker and changes courses, the problem for the undersea officer is naturally vastly less simple. It is also possible to pursue a fleeing ship upon the surface, taking advantage of the higher speed possible when driven by the "top-side" power-plant; only diving as a measure of caution when within possible range of her guns.

The foregoing has scarcely been needed to show that "what goes down, must come up" as far as U-craft are concerned. For this reason, defense against their depredations consists in having something on the spot to "swat" them when they appear. Of course other means are employed as well; steel nets are spread in infested waters, mine fields are laid, and floating contact mines scattered, but the most effective and most adaptable counteragent has proven to be the boat on the spot, the armed patrol.



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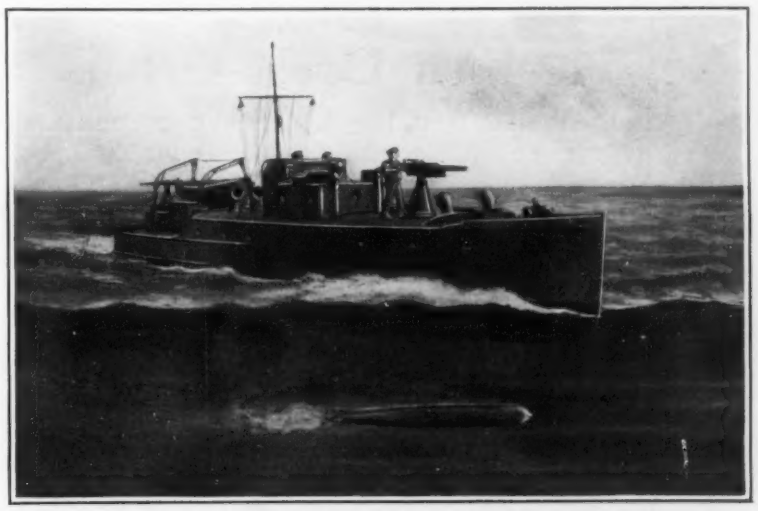
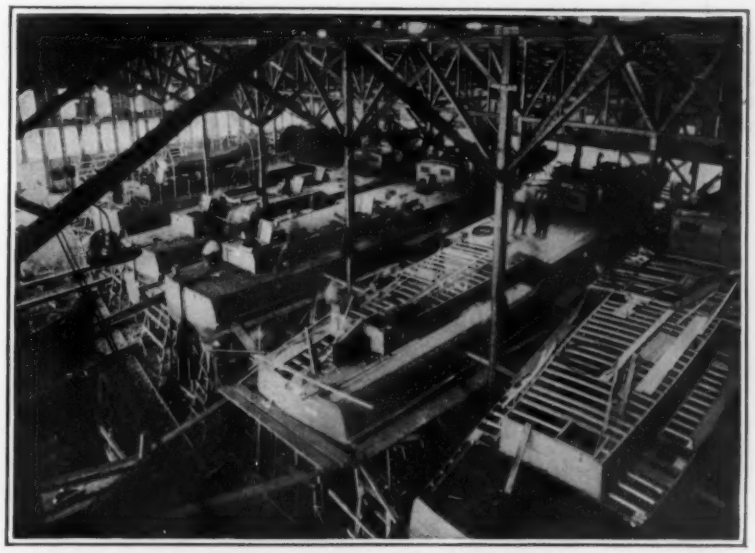
Stretching a steel net across the Narrows, New York Harbor



Submarine chasers are of too slight a draft to be hit by a submarine torpedo



Manufacturing submarine chasers for the British Navy at the rate of three per day

In the first periods of the submarine menace, the British met the inroads upon their shipping by scattering upon the waters adjacent to their home ports numerous small armed craft of almost every description. They were dealing with relatively slow U-boats that to be effective had to frequent coastal waters where sea-traffic was thickest. For this reason, and for reasons of international policy, the area of their operations was restricted, so that number was the controlling factor in the vessels designed to combat them. But as the war went on, submarines were made larger, were given greater speed, above and beneath the water, and were armed with heavier guns. This caused a specialization of patrol boats, so that now they are practically small torpedo craft minus the torpedo. The latest British type is 80 feet long, of 12-foot beam, and slightly more than 4 feet in draught. Five-hundred horse-power engines drive them. Their cruising radius is 700 miles at 22 miles per hour, or 1,500 miles at 14 miles per hour. They mount a 3-inch gun.

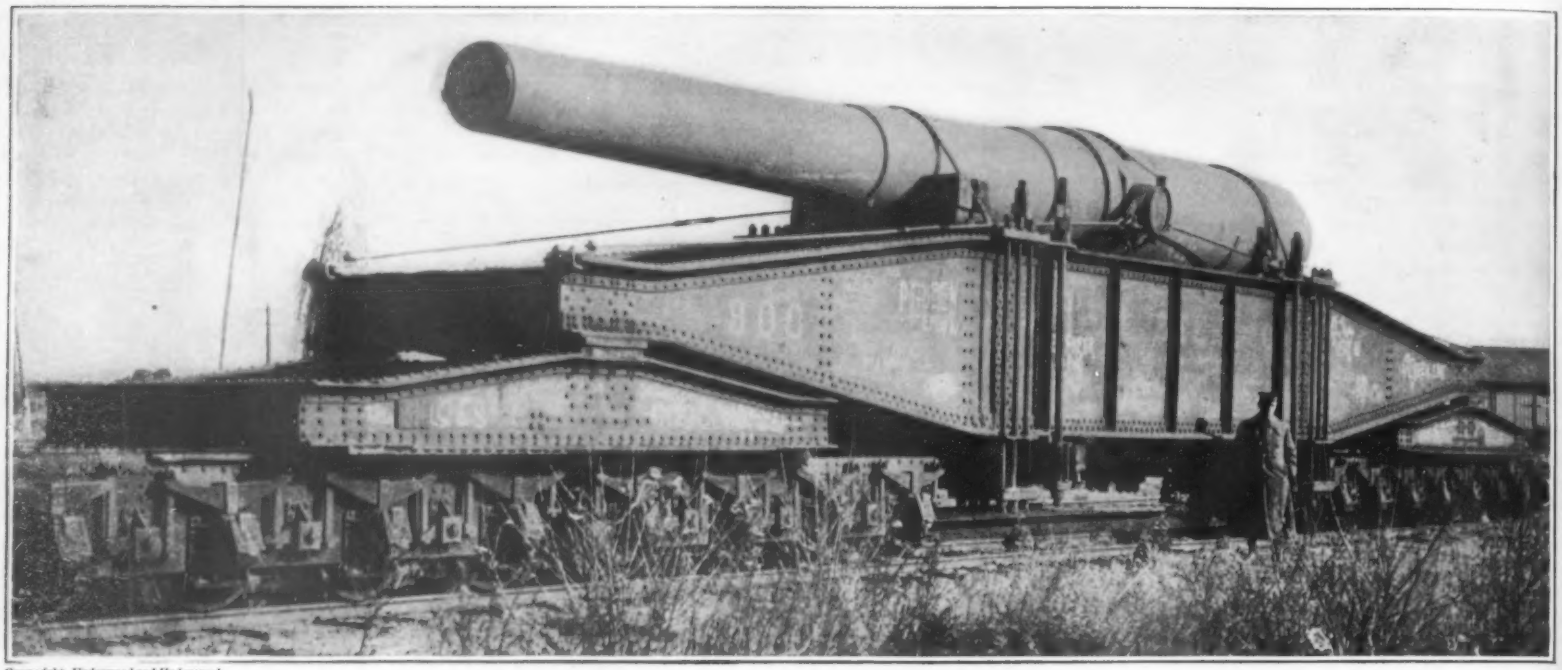
It is of course impossible to describe in detail the steps that have been taken to make our patrol service effective. Only a very meagre and sketchy outline can be given with propriety. We have three types, or rather sizes, of boats, since all are built upon the same general plan, and are almost identical in appearance. Some of these boats have been built for the Navy, the others for private individuals with approval by officers of the Navy. The largest class are to be considered small heavily-armed destroyers, capable of meeting on equal terms the largest submarine cruisers. Their speed is nearly double that on the surface of a fast sub. They are the mobile combat-ships of the anti-submarine service. The second class, able to carry a crew of at least fourteen men, and armed with lighter guns, are intended for use in restricted waters, under such conditions that a U-boat must, if it rises, be within range of at least one of a patrolling fleet of these sturdy vessels. Their speed is not so great as that of their larger sisters, but is ample. The smallest type carries but eight men, two rapid-fire guns, and a special gun with an anti-aircraft feature. They are faster than the surface speed of a large sub, but are intended only for harbor-patrol and shipping-control duty.

No evidence has come through to show what the English consider to be the tactical unit in their service. Seemingly, they send a boat out on a sort of Donnybrook Fair mission, "see a head, and hit it." We do not believe that the best results can be secured without systematic coöperation, so have developed the squadron of twelve boats as our unit. This number always works together, and all problems are solved on this basis. For ease of control each squadron is separated into two divisions of six boats, under the command of a division officer, but this splitting has no military significance. Up to the present, the organization of privately owned vessels into squadrons, and their officering and manning have been in the hands of civilian associations. The training of the personnel has been carried out under the direction of naval officers during maneuvers in conjunction with surface and subsurface craft of the Navy. Under the law, recently enacted, creating the United States Coast Defense Reserve, these organizations, semi-officially attached to the various naval districts, are being taken over into the regular establishment.

The squadrons work in conjunction with agencies of detection afloat and ashore. When word is received at a base that an enemy craft has been detected passing into a certain zone, steps are at once taken to make sure the safety of adjacent harbors. While these harbor defense measures are being executed, a squadron of patrols is sent out, backed by one or two larger craft in reserve. The latter take up a position determined by the lay-out of the area, while the patrols spread out and sweep the zone, until the enemy passes out of it or rises to the surface. If he passes out of the zone without showing himself, the patrols pursue into the new area as soon as they receive notice that he has crossed the boundary. There the sweeping is resumed. If the hostile rises and is within range, he is sunk or is forced to submerge. If he is not within range and has time to man his guns, a guard-ring is formed around him until the larger craft, which occupy successively pre-determined posts, come up and engage him upon satisfactory terms.

Bases are established in positions convenient to the guarded sections, and from these, reliefs start out upon the expiration of the tour of duty of a squadron, so that during the presence of a raider, the watch is unceasing. Upon return to the shore-station, the crews are sent to their living-quarters and mechanics prepare the boats for an instant return to sea. In case of emergency, reserve crews are put on board and the squadron sent on duty again. In this way the maximum of use is obtained from the materiel without exhausting the personnel.

Unfortunately for our national safety, the above system, modified to meet conditions, has been established to protect certain vulnerable districts only; if all our harbors are to be properly guarded, the anti-submarine patrol should be established on our entire coast.



Our first 16-inch coast-defense gun, built over fifteen years ago. It is shown on the way from the factory to the proving grounds
The new 50-caliber, 16-inch guns will have 50 per cent greater energy

The New 16-Inch Coast-Defense Gun

The Powerful Rifle Which Will Form the Chief Weapon of Our Coast Defenses

WHAT would you think, gentle reader, of a gun which was capable of projecting your five-seater, 2,400-pound automobile for a distance of 27⅓ miles, and in the effort to make it travel so far, sending it skyward to a maximum height of 8⅓ miles? Or, to put it another way—would you not have considerable respect for a weapon, which, if mounted on Governors Island, and elevated to 45 degrees, would be capable of throwing your automobile as far as Tarrytown, and causing it to rise skyward to such a height that if at Yonkers you could place the Matterhorn upon Mt. Blanc, and Jungfrau above the Matterhorn, your automobile would clear the snowy peak of Jungfrau with several yards to spare?

Now, of course, there is no gun in the world that could perform this feat, for the reason that even if it got the automobile started with a velocity of half a mile a second the air resistance, due to the large surface presented by your machine, would cut down the velocity so quickly, that it would not get very far, even if it could hold together, before it crashed to earth.

But suppose you took the equivalent weight of your machine in steel, and forged and turned it into a projectile 16 inches in diameter and about six feet in length, and drove that out of the gun, with all the energy of 900 pounds of smokeless powder developed on the base of it, your shell would leave the muzzle at a velocity of 2,700 feet a second, and with an energy of 121,430 tons and it would soar into the heavens until, in passing above Yonkers, it would clear the summit of our three superimposed greatest of the Alpine mountains, and then sweep in a majestic downwardly curving, parabolic curve, until it landed at Tarrytown-on-the-Hudson.

Now there has been designed by the Ordnance Department of our army, a 16-inch gun which will be theoretically capable of doing all of that, and much else besides. This gun will be the latest of a series of powerful weapons with which the coast fortifications of the United States have been equipped, during the two decades or more which have elapsed since the Endicott Board drew up the plans for this great work. The original plans called for the emplacement in our forts of high power guns of 8-, 10-, 12- and 16-inch caliber. The first installation consisted of 8-, 10- and 12-inch guns, together with 12-inch mortar batteries. These pieces were adequate to meet the armament carried by most foreign battleships of their day; but their limited range, though ample at the time they were designed, is too limited to match the long-range, high-velocity ordnance of present-day ships. Thus the 12-inch, 40-caliber rifle, which fired a 1,070-pound shell, with 2,250 feet-per-second velocity, because of its limited elevation of 10 degrees had an effective range of only 13,000 yards. It was designed to have 2,500 foot-seconds velocity; but this was cut down to 2,250 foot-seconds in order to reduce the heat action in the gun and lessen the erosion.

When the Ordnance Department, over which Gen. Crozier presides, brought out the 40-caliber, 14-inch gun, in order to prolong its accuracy life the muzzle velocity was kept down to 2,250 foot-seconds, although this has lately been raised to 2,350 foot-seconds. This gun fires a 1,660-pound shell with a muzzle energy of 63,637 foot-seconds, and it will penetrate 12 inches of the side armor of a ship at 15,000 yards. This is a great advance on the 12-inch gun, which can get through 12 inches up to a range of 9,000 yards only, although the object of the design was not to secure increased power but, as stated above, longer life.

The original Endicott plan called for the mounting of a large number of 16-inch guns, and about twenty years ago construction was commenced on a 35-caliber piece of this caliber. The gun was completed and tested many years ago at Sandy Hook, where, if we remember rightly, it delivered a 2,400-pound shell with an initial velocity of about 2,300 foot-seconds and a muzzle energy of something over 80,000 foot-tons. At that time, however, there was a tendency to keep down the caliber of guns and get the requisite energy by increasing velocities; and it was considered that, since the 12-inch gun was master of the 12-inch plate at the fighting ranges of that day, there was no call for the construction of huge pieces of the weight of the 16-inch gun; and so, for many years, this great weapon remained at the Sandy Hook proving grounds and no disappearing mount was built for it.

The unprecedented ranges at which the naval engagements of the present war have been fought, namely, 17,000 to 20,000 yards for the opening ranges, have brought up the question of increasing both the range and power of our coast fortification guns, and hence, the extraordinarily powerful and heavy 16-inch gun, which forms the subject of our illustration, was designed and is now being built, and will form the principal armament of our coast fortifications and of the defenses of the Panama Canal.

By way of conveying an impression of the stupendous size, power and performance of this weapon, we have prepared the accompanying wash drawing. At the top of the picture is shown the gun as it will appear when mounted on the Buffington-Crozier disappearing mount. Below, the gun is shown standing on its breech in front of the New York City Hall; and it will be noted that its 69 feet of length brings muzzle up to the base of the tower, and well above the roof of the building. Below this is shown the line of its theoretical trajectory, and as noted, the gun, if fired at an elevation of 45 degrees, would hurl its shell through a great curve which at its highest point, would be eight and one-third miles above the Hudson River—the shell finally landing at Tarrytown, 27⅓ miles, as the crow flies, from the Battery.

But perhaps the most impressive evidence of the enormous energy developed in this projectile of over a ton weight, is that afforded by the drawing at the bottom of our picture, to understand which we will have to go back some thirty years in the history of naval ordnance.

We have received the following letter as we go to press. It will be understood that our drawings are based on the theoretical velocity, energy, etc. The ballistic results which will be attempted at the proving ground, as given in Gen. Crozier's letter, are as follows:

To the Editor of the SCIENTIFIC AMERICAN:

"The ballistic data furnished you for the new 16-inch gun give to this gun a muzzle velocity of 2,700 feet per second, with an energy of 121,430 foot-tons. This velocity is theoretically practicable according to approved ballistic formulæ, but as this gun is experimental in the sense that it exceeds in power guns previously designed and manufactured by this Department, I much prefer to make a more conservative statement as to its power until such time as the gun has been actually tested and its power accurately determined. I would therefore suggest that the article as published give this gun a velocity of 2,600 feet per second and not 2,700 feet per second. The energy corresponding to a muzzle velocity of 2,600 feet per second is 112,600 foot-tons."

WILLIAM CROZIER,
Brig-Gen., Chief of Ordnance.

Washington, D. C.

Our new 16-inch coast-defense gun, if fired from the Battery with 45 degrees elevation, would reach New Brunswick, Plainfield, Boonton, Nyack, Tarrytown, White Plains, etc.

Somewhere around the year 1887, the British brought out three battleships of the "Benbow" class, which carried, each, two guns of 16¼-inch caliber. This was the mightiest gun of its day. It was a short gun, of only 30-caliber length, and it delivered its 1,800-pound projectile with a muzzle velocity of 2,087 feet per second and a muzzle energy of 54,390 foot-tons. And just here, by way of showing how important an element in projectile energy is the velocity, we may mention that the 50-caliber, 12-inch guns, carried by our "Arkansas" and "Wyoming" battleships, have about the same energy, and far greater penetrative power, than this "monster" gun of the '80's.

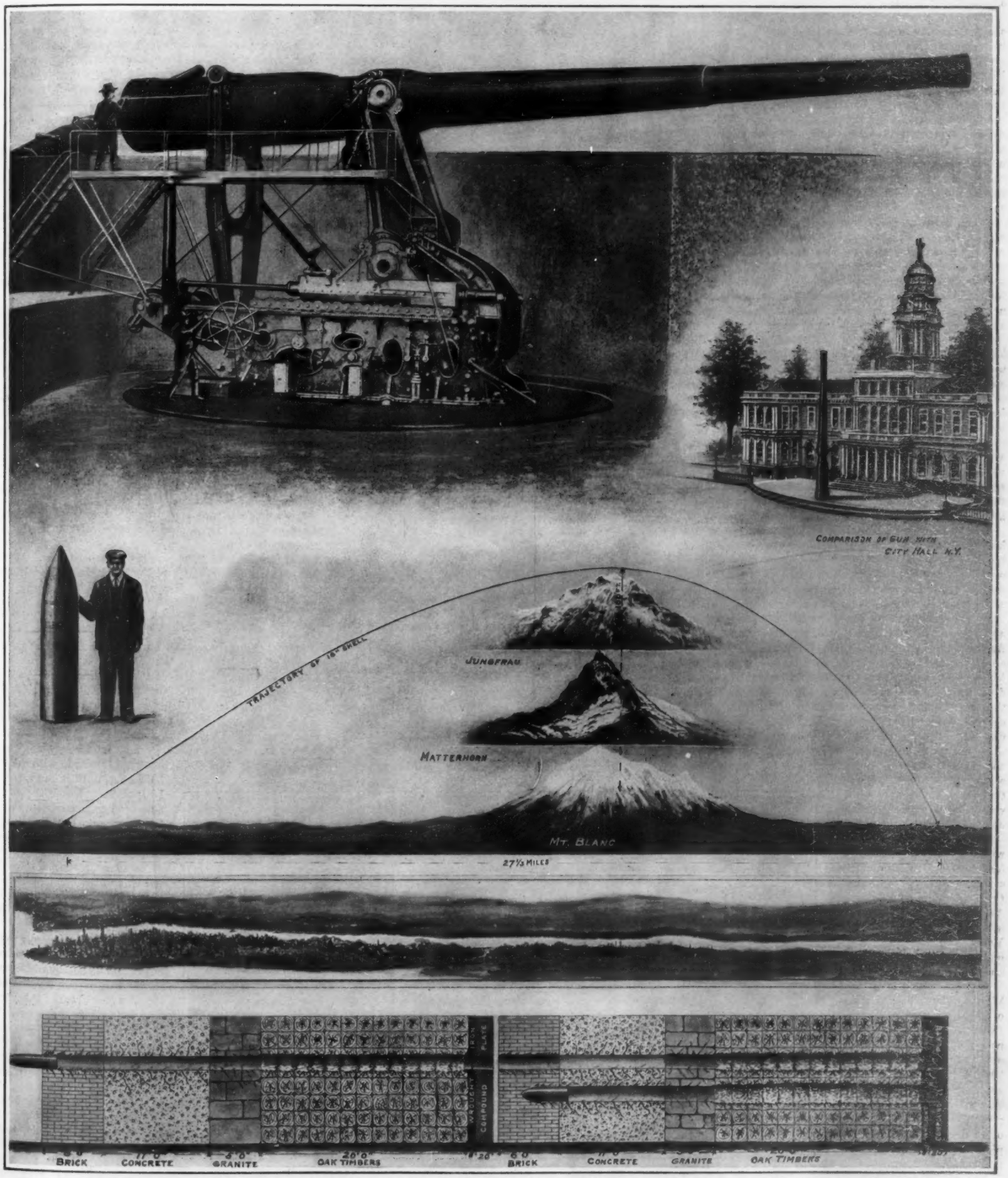
Well, in order to demonstrate just what this gun could do, the British built the target forming the right-hand half of our lower cut, whose total length was about forty-four feet. When the shell struck the target, it passed through 20 inches of compound steel armor, eight inches of wrought iron, 20 feet of oak, 5 feet of granite and 11 feet of concrete, finally coming to rest after penetrating three feet into a massive brick wall. Now, our modern 16-inch coast defense gun would not fetch up in the brick wall, but would pass through it, and would have enough energy left to pass entirely through a second 44-foot target of the same makeup, with over 12,000 foot-tons of energy still unspent.

The 16-inch gun is of the wire-wound type, that is to say, it consists of an inner tube, upon which steel wire of great tensile strength, and about an eighth of an inch square in section, is wound under heavy tension. This wire resists the bursting stresses of the powder, and it will interest the reader to know that the length of wire wound on this particular gun would be sufficient to stretch from here to Boston and some fifty to sixty miles beyond.

As a final measure of magnitude in this gun, we offer for the reader's contemplation the fact that to fire a single round with an armor-piercing projectile will cost Uncle Sam the neat little sum of $1,680.

New National Telephone in Panama

The Government of Panama has authorized the installation of a telephone line in the Province of Colon, along the Atlantic coast, starting from the city of Colon and terminating in Santa Isabel. This telephone will be installed in the offices of the public officials of the towns through which it passes, and such officials will be in charge of the service, charging the usual government rates. Bids will be called for on the contract for installing the line, and work will be begun within three months from the date of the law, December 2d, which is published in the *Gaceta Oficial* of December 6th. An appropriation of $25,000 is to be included in the budget of the next fiscal year for the installation and maintenance of this national telephone.



Length, 69 feet; *weight*, 340,000 pounds; *weight of shell*, 2,400 pounds; *muzzle velocity*, 2,700 f. s.; *muzzle energy*, 121,430 foot-tons; *penetrates 12-inch armor at all ranges*

The 16¼-inch British naval gun pierced a special target as shown above. Our gun, built 30 years later, would pass clear through two such targets, placed end to end

OUR NEW 16-INCH, 50-CALIBER, COAST DEFENSE GUN

The Battle of The Caribbean

A Modern Sea Fight as It Would Look from the Fire-Control Platform of the "Oklahoma"

By J. Bernard Walker

HOW it came about that I witnessed one of the greatest naval battles of all history from the fire-control platform of the flagship "Oklahoma" is readily explained. In the previous year I had offered for the consideration of the Navy Department a system of "director firing," which had been rejected on the ground that its mechanism was too delicate to stand the shock of battle.

The Department was developing a system of its own which gave great promise of success; and, in recognition of my interest in the subject, I had been invited to witness the final tests of the installation during the spring target practice of the "Okalahoma."

There are moments in one's life which stand out with sharp definition amid the crowded and more or less blurred memories of the past. Among these I shall ever reckon the breakfast hour, on the morning of April 1st, 1916, in the wardroom of the "Oklahoma", flagship of the United States Atlantic Fleet, which was at anchor, on that particular day, off Vera Cruz.

The conversation in the wardroom mess had been drifting along in a desultory way, when an orderly entered with a request for the presence of the executive officer infthe Admiral's cabin. In a few minutes Commander Burnley returned, holding in his hand a wireless message. There was that in his face which caused a sudden hush.

"I have here a radio message from Washington by way of Key West," he said, "which I will read: 'Germany has declared war on the United States. Have information German advance fleet is following southern course for Caribbean; second fleet on northern course for our Atlantic coast. Proceed full speed for Guantanamo Bay, Cuba, to take on fuel and supplies. Find and destroy weaker advance German fleet.' "

Shortly before midnight of April 5th the "Oklahoma" led the way into Guantanamo Bay, Cuba. The 6th was spent in coaling, taking aboard full supplies of stores and ammunition, and sending ashore the boats and all superfluous ship's furniture. On the 7th, shortly before dawn, the fleet, stripped for action, sailed to the eastward, to "find and destroy the enemy."

Overnight, Admiral Willard, Commander-in-Chief of our fleet, had thrown out to the eastward a strong scouting force—such as it was—strong in numbers, but utterly inadequate for its purpose. It consisted of the three armored cruisers: "Washington," "North Carolina," and "Tennessee" and four divisions of destroyers.

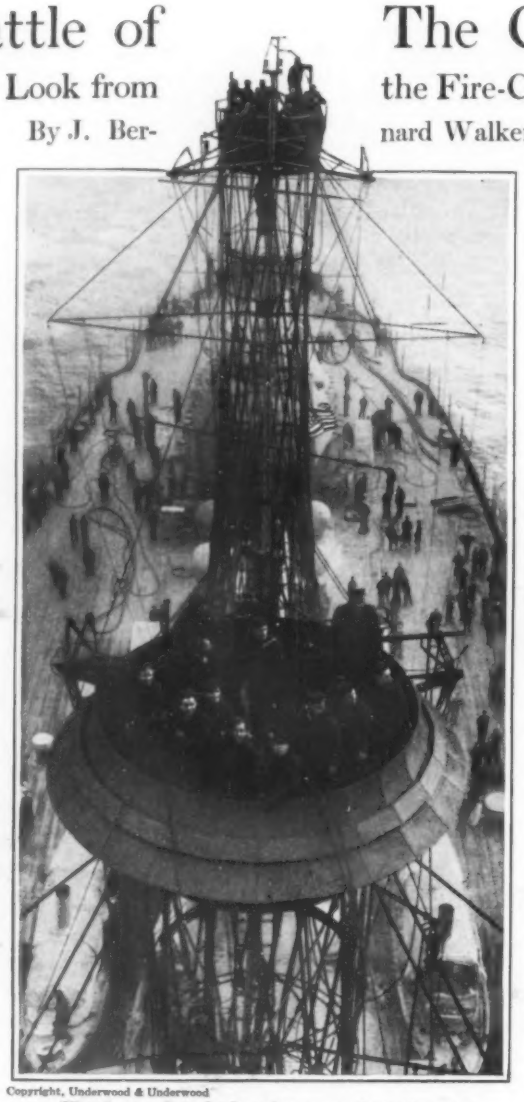
The cruisers were powerful ships carrying four 10-inch and sixteen 6-inch guns, and they were capable of breaking through any screen of the German light cruisers of the Karlsruhe type; but they would be utterly at the mercy of the 28-knot battle-cruisers possessed by Germany, their best speed being only a little over 22 knots.

By the courtesy of the executive officer, I found myself on the forward fire-control platform of the "Oklahoma." As we cleared the entrance to Guantanamo Bay and swung around to the eastward, from my station, 120 feet above the sea, I gazed with no little pride at the two divisions of dreadnoughts strung out astern, ship beyond ship at 500-yard intervals, in a stately column which covered some three miles of water. Below me was the flagship, fresh from the builders' hands. Truly a noble ship, her powers of offense, represented by ten 14's and twenty-two 5's, being matched by the massive armor, 13½ to 18 inches in thickness, the like of which was to be found in no other navy of the world.

Five hundred yards astern, with a white feather of foam curling from her shapely stem, was the "Nevada," twin sister to the flagship. Astern of her, at the same interval, were the "New York" and "Texas," carrying each a battery of ten 14's and twenty-one 5's.

A wonderful piece, that 14-inch, the pet and pride of the officers and men. Down at Indian Head it had passed its proving tests triumphantly. At a distance of 10,000 yards, the projectiles were capable of passing clean through 16 inches of Krupp armor. Elevated to its limit of 15 degrees, the gun could place a shell on a ship twelve miles distant.

And there were forty of these guns that could speak at once, and twice a minute each, in the first four ships of our line.



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The forward and after fire-control platforms of the "New York"

Astern of the "Texas," I saw those stately ships, the "Arkansas" and "Wyoming," mounting, each, twelve 12-inch guns in its six turrets, with a battery of twenty-one 5-inch rapid-firers to repel torpedo attacks.

Seventh and eighth in line were the twin sisters, "Utah" and "Florida," each carrying ten 12-inch guns and sixteen 5-inch. Last in the line were the "Delaware" and "North Dakota," our earliest dreadnoughts, mounting ten 12's and fourteen 5's.

Every ship could fire its whole broadside on either beam, and in every minute of the coming engagement we would be able to hurl at the enemy 110 tons of projectiles, every one of which, if it landed squarely, would pass entirely through the belt armor of the enemy and burst in the interior of the ship.

Ship for ship and gun for gun, we knew that we could crush that German fleet, which, the radio had told us, was approaching somewhere to the eastward.

But where was the enemy? In what strength was he? And, most important question of all, how did he shoot?

Before the sun, which I noted was just showing the golden edge of his rim above the horizon, had set, those questions had received their answer amid the fruitless heroism, the catclysmic destruction, of the greatest sea fight in naval history.

* * * * * * * * *

I remember it was while six bells were striking that there came the following radio call from one of our scouts, the armored cruiser "Washington": "Approaching St. Nicholas," it said, "sighted screen of five battle-cruisers of the enemy, steaming abreast, distance 20,000 yards, covering a column of eight ships, apparently battleships. All are heading west. Am returning full speed, 22 knots."

At 7:15 A. M. came another message: "Enemy in chase, has opened fire at 18,000 yards and is coming up fast." And then the story came in quick sequence.

At 7:30: "Enemy at 15,000 yards is using forward 12- and 11-inch guns on all five ships. Am replying with two after 10-inch."

At 7:40: "Received two shells, raking starboard battery."

At 7:45: "Shell in boiler-room and two funnels gone. Speed 15 knots."

At 7:55: "Steering gear gone—after turret disabled—heavy casualties—am shot to pieces—going down by stern, colors flying—sorry cannot give details battleship fleet—our position is lat.——!"

A wireless call was sent for our destroyers to rejoin the fleet at full speed, and the speed of the fleet was raised to 18 knots.

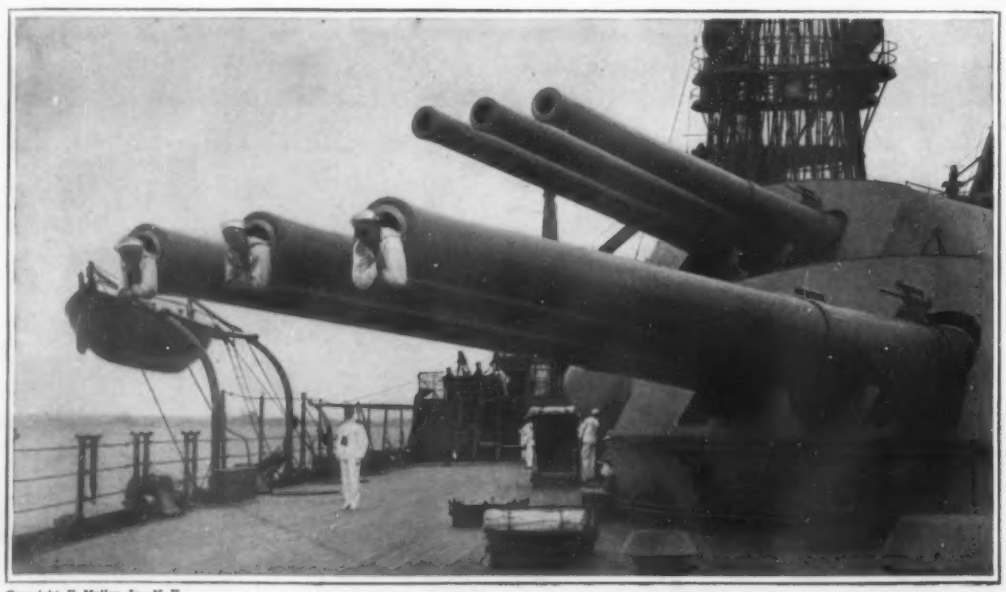
And then we saw them—on the starboard bow. First the masts, with the flutter of the battle-flags discernible; then the smokestacks, the turrets, the hulls, and yes, the five battle-cruisers, which only a brief hour before had sent the "Washington" with her gallant company to the bottom.

And then, up over the horizon, silhouetted sharply against the eastern sky, there came, a mile or more astern, the van of the battleship line—one—two—three—eight in all: the German dreadnoughts. And now the battle-cruisers began to swing around, at full speed, in a wide turn to port, following in the wake of their flagship, "Derfflinger," making a turn of sixteen points, and heading east. Simultaneously, each ship of the two battleship divisions swung around, with helm hard over, until it had turned 16 points. When the maneuver was completed, the Germans were heading east in two parallel columns, the battleship column abreast of us at a distance of 16,000 yards, and the battle-cruisers some 5,000 yards off their starboard bow and 21,000 yards from our line.

In order to secure more of an offing from the Cuban coast, and obtain ample room for maneuvering, our Admiral signaled for every ship to turn four points to starboard; a maneuver which was instantly followed by the Germans.

"Ha, Ha," laughed an ensign, who, with his eye at the rangefinder, was calling the distances into a telephone mouthpiece, "they don't want to come too close to our 14-inch guns; and as for the battle-cruisers, they are going to stay out of the scrap al-

Diagram of the Battle of The Caribbean



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Turrets No. 1 and 2, of the Pennsylvania, showing how this ship can concentrate six 14-inch guns ahead She has a broadside of twelve 14-inch guns

together; for at over 20,000 yards their 11's can never reach us."

"You are wrong there," said Lieutenant Carlisle, the spotter, "the German batteries can elevate to 30 degrees, which is just twice as much as we can. Their 12's have the advantage in range, carrying up to 26,000 yards, as a matter of fact. See that? They are trying a ranging shot at 21,000 yards."

And, sure enough, there was a flash from the forward turret of the "Derfflinger," and thirty-five seconds later, with a deep moaning roar, a shell passed over our heads and dropped into the sea, five hundred yards beyond the ship.

And now, Admiral Willard, having obtained sufficient offing, brought his fleet back into column again, ready for the great trial of strength.

There was another flash from the "Derfflinger," and half a minute later the shell struck 300 yards to starboard of the "Oklahoma."

"Good shooting," said the ensign, "now for the salvo."

But it did not come—not yet. Instead, the leading ship of the German dreadnought column tried for range. The shell struck 400 yards short. The next was 600 yards over. And then came the salvos. From both ships there burst a flash of flame, from the battle-cruiser first and, a few seconds later, from the dreadnought—and the "Oklahoma" was the target of each.

With a crash that seemed to rend the heavens, those twenty 12-inch shells "straddled" our ship, one making a square hit on our belt and the others striking the sea on either beam, and sending up vast columns of water that rose some 250 feet in the air, and fell like broken waterspouts upon our decks. We on the fire-control platform were drenched and found ourselves standing over our boot-tops in water.

But what of the "Oklahoma"? Had her guns been silent? Far from it.

As soon as the German columns straightened out after their turn to the eastward, Ensign Brown at the range-finder began to telephone the range to the fire-control station below decks. "Sixteen thousand five hundred yards; 16,200; 16,000; 15,500; 15,000." And looking over the rail, I noted that the three guns in No. 1 turret were lifting their muzzles. Then came a snapping crash, a burst of flame, a drift of light-brown smoke, and the 1,400-pound shell from the center gun was away on its flight. Thirty seconds later a beautiful snow-white column rose a little short of the German flagship and slightly astern. The "spotter," his eyes glued to his glasses, called into the mouthpiece of his telephone: "Up 300; left 6."

Down to the central station below the water-line went the message. The necessary corrections in the elevation of the gun were there figured out and telephoned to the sight-setter at the gun. Again a shell sped to the mark.

This time the splash was beyond the ship and ahead. "Down 200; right 3, called the "spotter." And now the necessary corrections being made on every gun in the ship's battery, the fire-control officer, holding the cross-hairs of his telescope on the German flagship, pressed a button and all the 14-inch guns in our battery let go together, and the ten 1,400-pound shells soared into the heavens, visible for a few seconds to the eye. There was a magnificent burst of water at the German flagship, and as it fell away, through my glasses I could see that her after smokestack was gone. The ragged outline of her deck, moreover, showed where the shells had burst inboard, lifting the deck, and apparently jamming the after turret.

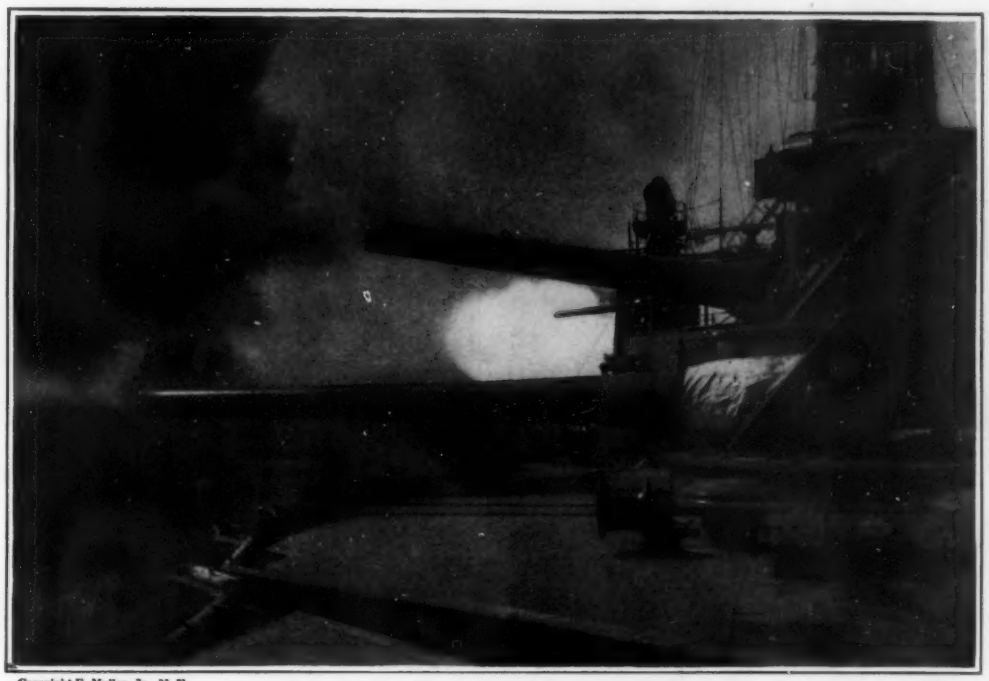
And when the flagship had spoken, every ship down our line burst forth in flame and fury. The Germans fired with greater frequency and the storm of their shells, striking the water, raised such a mass of broken spray that, at times, I could see no farther than the second ship astern.

The American ships fired with greater deliberation, and evidently, with greater accuracy. Moreover, against a combined broadside for the enemy dreadnoughts of thirty-two 12's and thirty-two 11's, we opposed a total broadside of forty 14's and sixty-four 12's. The fire of the German battle-cruisers at 20,000 yards was too inaccurate to be much more than annoying, although some deck hits were made.

After ten minutes of furious fighting, superior weight of metal began to tell. The flagship "Thuringen" with one smokestack gone and the after turret out of action, began to slow down; finally dropping to the rear, leaving the "Helgoland" to lead the line. Later, she picked up and took station at the rear of the German column. Then the "Oldenburg," second in line, took a sudden sheer, and began to circle, finally coming back on her own line and cutting in between the "Thuringen" (last in line) and the "Posen." A 14-inch shell striking fair on the conning tower had wrecked it and jammed her steering wheel. Ultimately, she straightened out, 1,500 yards astern of the column, which slowed down to cover her until she closed up.

The first ship to be put out of action was the "Nassau," which succumbed to the concentrated salvos of the four leading ships of our line. Under the impact of their 14-inch shells, it looked through our glasses as though a

(*Continued on page 245*)



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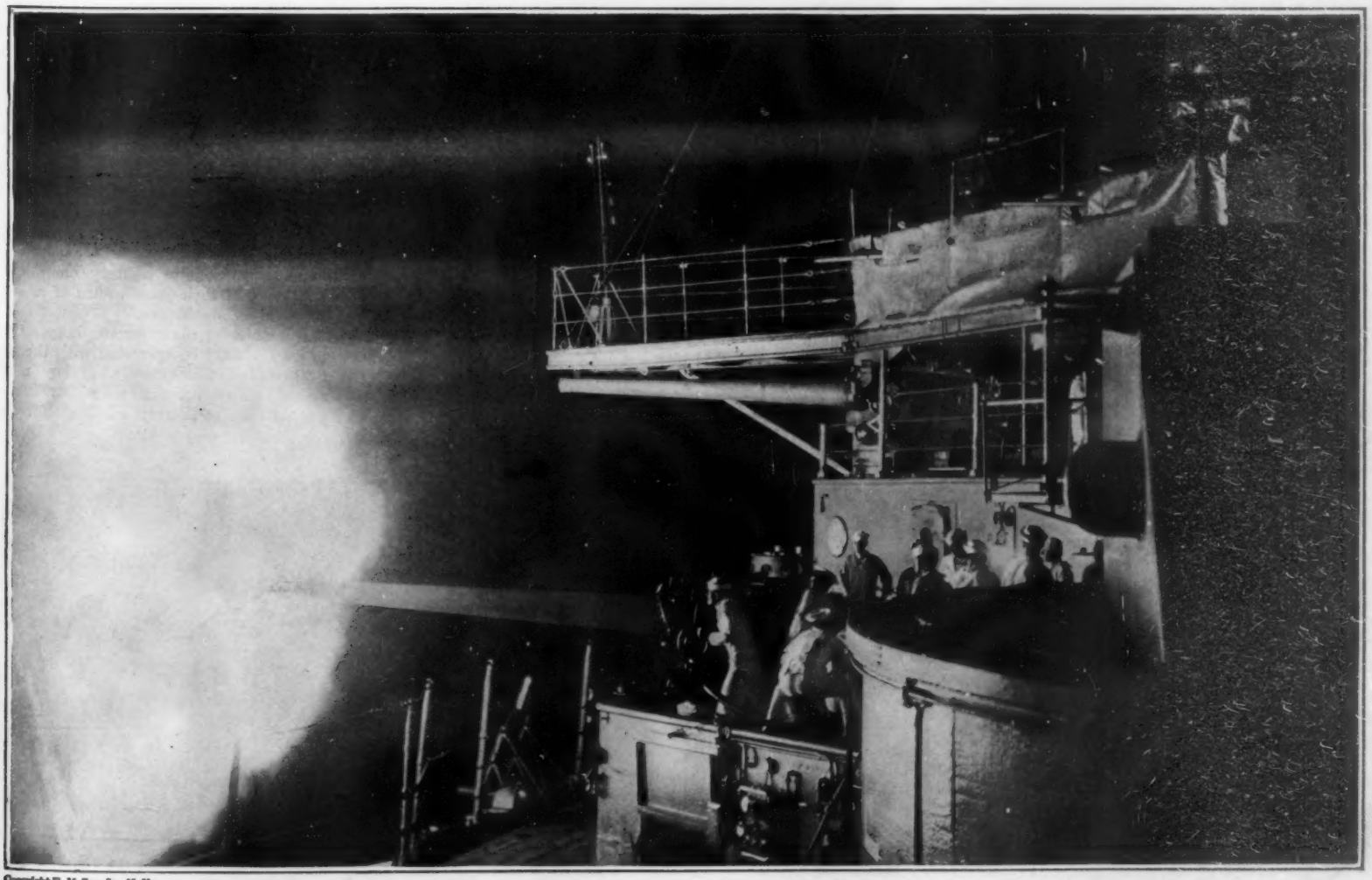
One of our dreadnoughts, stripped for action, is here shown using her heavy guns in battle practice



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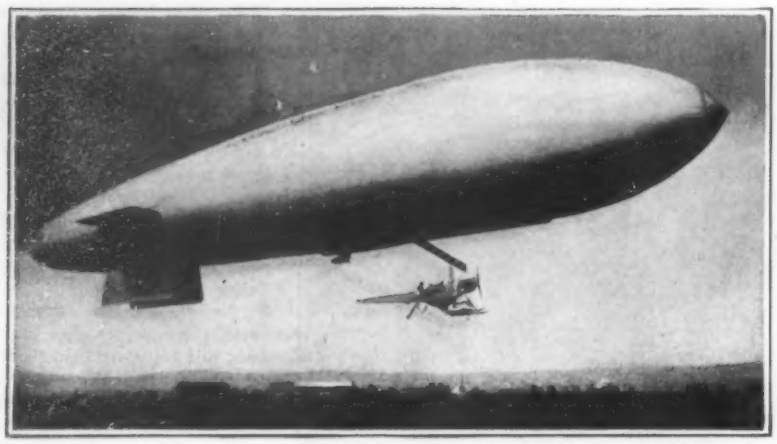
Five-inch rapid-fire battery repelling a night attack by the enemy's destroyers. This photograph was taken by the flash of the discharge



The "Blimp" type of dirigible, which has been most successful in the hands of the British

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A British kite balloon ascending from the hold of a mother ship, "somewhere in the Orient"

Our Aerial Coast Defenses

The Rôle of American Aircraft in Coöperation with Coast Fortifications and Naval Units, and the Meaning of the Aerial Coast Patrol

THE history of the great naval battle of Jutland would now read quite differently if it had not been for the presence of the sinister gray Zeppelins which, perched a mile or more above the German High Sea Fleet, effectively coöperated with the Teuton commanders. For instead of reading, as we do, that the German fleet inflicted serious punishment on the battle-cruisers of Admiral Beatty, whose strategy was to hold the German fleet until the arrival of the British Grand Fleet, and that the Germans, fully aware of the approaching British Grand Fleet, chose to turn and steam at full speed for home ports, thus foiling the British plans—instead of reading these historic facts, we might conceivably read another account of the battle, somewhat after this fashion: The Germans, preoccupied with the task of smashing Beatty's fleet, were not aware of the rapidly approaching Grand Fleet until it was too late to escape; hence they were forced to engage in a disastrous combat with the overwhelming forces, which resulted in the practical annihilation of the German High Sea Fleet. All of which means, in sum, that it was a Zeppelin observer, or perhaps a number of observers, who, from his mile-high lookout, saved the German fleet from almost certain destruction.

Among others the United States Navy has come to appreciate the value of aircraft, particularly the advantages of seeing the enemy before he sees you, as expounded by the Jutland fight. And with the present unsettled state of our foreign affairs, with the prospects of our being plunged into war at almost any moment, the subject of aerial preparedness in conjunction with the Navy and with coast defense must necessarily be one of paramount interest to every American.

Just as the United States Army was the first army to have an aeroplane in 1909, so our Navy was the first navy to have a seaplane in 1911. Further, if our Army has woefully failed to keep pace with aeronautic progress made by other armies, so, too, our Navy has fallen far behind in the matter of the command of the air. Yet all the less is the excuse in the case of the Navy, for considering its rank among the naval powers of the world and considering the thousands of miles of coast line which we would be obliged to patrol and defend in the event of war, there is no reason why we should not have adequate aerial forces; in fact, our present position is little short of disastrous if we are shortly to engage in war with an aggressive enemy. In ante-bellum days the plea of ignorance might be advanced as a reason for lack of aerial preparedness; but the past 30 months of war has revealed to the belligerents and neutrals alike that the command of the air is often the first essential to success in naval and military operations.

Lamentably insufficient is the appropriation for Navy aeronautics available under the act of August 29th last, of $3,500,000, although it is now most likely that this sum may be increased at any moment by a further appropriation. However, as far as the personnel of the Naval aero service is concerned, it is entirely inadequate,

The launching of a seaplane from the after deck of the armored cruiser "North Carolina"

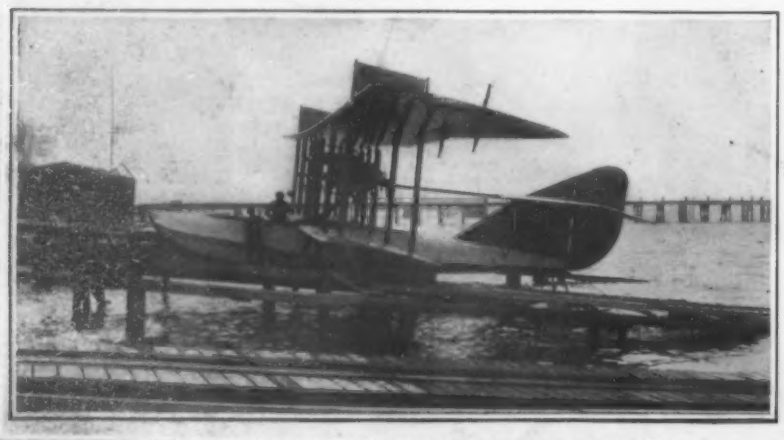
with no prospects of immediate improvement. The present personnel is distributed as follows: Officers authorized, 150; enlisted men authorized, 350; present number of officers, 53; present number of enlisted men, 163. The machines in service can be summed up as follows: Seaplanes, 37; kite balloons, 2; seaplanes awaiting decision as to disposition, 8. Aside from this equipment the following has been ordered: Seaplanes on order or awaiting acceptance, 40; kite balloons on order, 1; kite balloons awaiting survey, 1; dirigible undergoing trials, 1. In addition to the foregoing, it is understood that the Army and Navy are to coöperate in the securing of a Zeppelin type dirigible to be constructed in this country.

Formidable as the present personnel and equipment may seem to the layman, it dwindles to insignificant proportions when it is remembered that little Bulgaria, with an area somewhat larger than Maine and a population less than Massachusetts, has over 300 aeroplanes and perhaps well over 100 aviators; while the United States Army and Navy together have less than 100 aeroplanes and could hardly muster 50 aviators in an emergency. Comparison, therefore, with the aerial forces of England, France, or Germany, each with about 10,000 aviators and somewhat over that number of machines, is obviously ludicrous.

In order to arrive at some conclusion regarding the magnitude of the aerial equipment which should be ours for coast defense and naval service, it is first necessary to understand something of the function of such craft. It has been demonstrated in the present war that seaplanes must be divided into two broad categories: those of the fleet proper and those for coastal service. The seaplanes which accompany a fleet should be of two general types: first, machines for reconnaissance; secondly, machines for warding off hostile aircraft. Both these types should be housed on carrier-ships possessed of a speed sufficient to enable them to keep up with a battle squadron. For scouting and reconnaissance are required machines of good sea-going qualities, great speed, and average range of flight and load-carrying capacity. This armament should be designed purely for defence, since their chief duty would be reconnaissance, as swift as possible, and to keep their commanding officers informed of the presence and movements of the enemy fleet or submarines; and, in the case of an attack on hostile naval works, of the land and underwater defenses. These seaplanes would also be available for artillery observation, just as aeroplanes are now employed for the same purpose in military operations. Dirigibles, too, because of their great radius of action, are excellent for naval reconnaissance.

The coastal aeroplanes, on the other hand, operating from a base on land, should be entrusted with the defense of the coasts and naval works. They must include reconnaissance machines with a great radius of action and high horizontal velocity; machines for the

(Concluded on page 248)



A giant Curtiss flying boat, which, carrying five passengers, has a 500-mile radius of action

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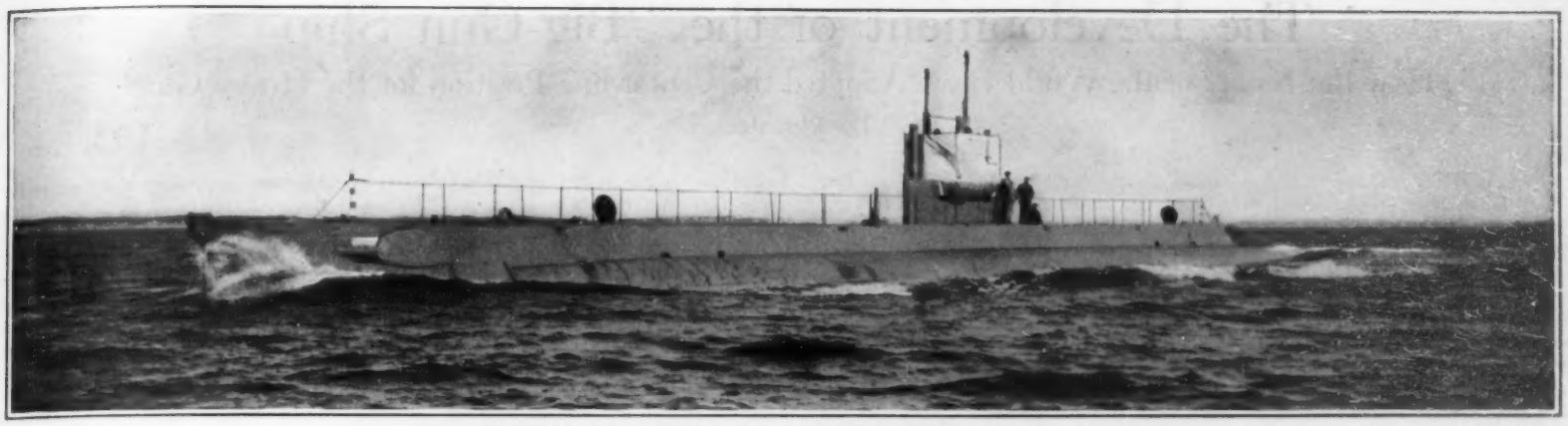
A 300-horse-power twin-motored Gallaudet seaplane built for the U. S. Navy
Note the stream-line system of propulsion



The M-1, our latest type of submarine on her trial trip off Provincetown, Mass.

Notes on Our Inadequate Submarine

A Weapon Neglected in the Land of Its Inception

By John Shegog

IT is safe to say that, as far as the American public is concerned, a serious misconception of the ruling principles of naval strategy exists. The popular conception is that there must be designable some particular class of ship that will provide in itself all the attributes of a well-rounded naval establishment. To this belief is chargeable the wide-spread clamor which so often arises when a building program is being drawn up for "submarines—nothing but submarines." Before the submarine demonstrated its great usefulness in its specific field of action, the feeling was that through the possession of numerous powerful battleships lay the only road to safety from invasion: dreadnoughts were supreme mistresses of the sea. The truth is, that all naval fighting machines, to possess the maximum of effectiveness, must be specialized to a very high degree. The direct consequence of this is that their effectiveness can be applied towards specific ends only, and that no one class of vessel supplies all the qualities required to ensure the defeat of a possible foe. In the past, we neglected the building of submarines; at the present, there is danger that we may build a disproportionate number of undersea craft unless there be full public understanding of the uses to which they can be best put.

Perhaps the supreme use of the submarine is for commerce raids by a nation that possesses a surface naval power too weak to control the seas. Operating at large against regular fighting craft, the U-boat has scarcely justified more than a negligible fraction of the claims made for it at the beginning of the war. As a means of defending a fixed area against the operations of a hostile fleet, underwater attack has shown itself to be a useful adjunct to shore-batteries, after the destruction or dispersion of the defending fleet. For this service, small vessels armed only with torpedoes can be used. But since protection of surface craft against torpedo attack is secured by a constant shifting of position, and since modern long-range guns and aerial fire control make it dangerous for major craft to remain long in one spot during attacks upon shore positions, speed is an element of successful U-boat operations. Also a limited cruising radius above and below spells a restricted area of operations; frequent returns to a protected base for replenishment of supplies can result only in a large loss of effectiveness due to time spent in getting on stations and in returning to base to outfit for another tour of duty. Hence, even for coast-defense duty, there should be provided large fast undersea craft of wide cruising radius, able to maintain their crews in fit condition for long periods.

The majority of American undersea boats do not meet these requirements.

Submarines of the K class

Note forward horizontal rudder extended in position used for steering when submerged. These submarines are seen here alongside their mother ship, to which they must often return in order that the officers and crew may properly eat and sleep.

It is a fact that all boats below our K type are small, and unsuited for extended operations. The accommodations for sleeping the crews are primitive; the cooking arrangements insufficient to keep men in health for more than say a week or so at the most. There is no provision for re-purifying the air. The result is that life on board is highly uncomfortable. That this is recognized is shown by the provisions made for a return at night to a "mother-ship" where the officers and crews eat and sleep.

On cruising duty, sea-sickness is no disgrace. It is said that when one of the D-boats made an outside voyage at one time the whole complement was ill. The weather was nasty, and outside ventilation hard to secure. The roll of the vessel, the smell of oil, and the breathed and re-breathed air made a combination unbearable even for the picked men of the crew.

Compare this again with the German craft. They have good sleeping accommodations for the crew, and a lounging-room. One boat had a phonograph. Their breathed air is freed from carbon dioxide by potash, is cooled and re-oxygenated by gas added to it from tanks of compressed air or oxygen. So compiete is their attention to the condition of their crews that men come in from a month or so of sea-duty in unimpaired health.

None of our smaller craft is equipped with deck guns. One engraving shows the subwater defenders of the Panama Canal. They are so slow as to be able to do little else than lie in wait for a chance shot at a foe.

Even our largest submarine, the M-1, is far behind modern achievement in this branch of naval construction. Her surface power plant develops 900 horse-power, that for driving her when submerged 340 horse-power, giving a surface speed of 14 knots and a sub-surface speed of 11 knots. The German U class, 18-17, 24-19, are listed as having 1,400 horse-power and 500 horse-power for surface and submersion, respectively. They were built in 1912-13. Their displacement is equal to that of the M-1. Their cruising radius is somewhat less than that of our vessel, 2,000 miles as against a guaranteed radius of 3,500 miles. Now there is a rumor that the Germans contemplate a submarine cruiser of 5,000 tons displacement: 1,200 tons has become usual.

It is doubtful if the United States need, at the present moment, try to reach this mark, but our undersea fleet must be given speed and more speed; it must be able to chose the objective of its attack and deliver its blows where and when it will. Its effectiveness must not depend upon chance throwing in its range the marks upon which to launch its blows.

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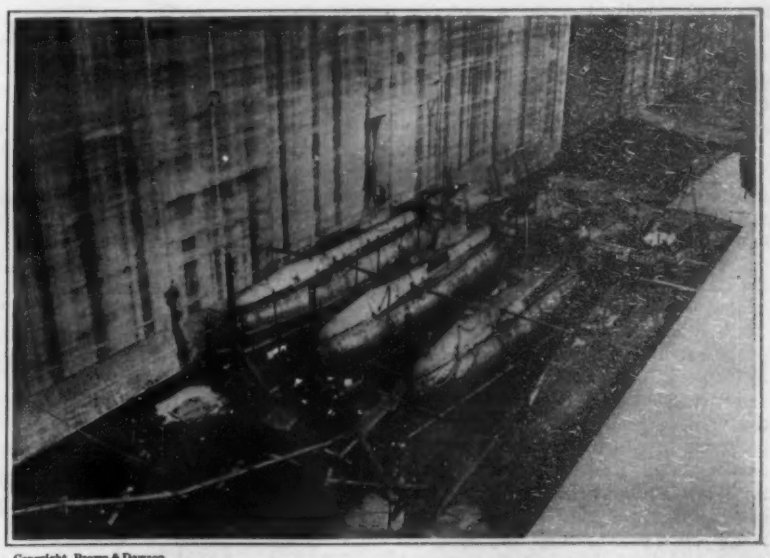
Submarines made for Great Britain but held in Boston, Mass., for reasons of neutrality. Transferred to Chilian government by British government in payment of Chilian warships building in England and seized for British navy



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C-Boats dry-docked in a lock of the Panama Canal. These were built in 1909 and are of but slight war-power. Displacement on surface, 238 tons; submerged, 275 tons. Speed on surface and submerged, 11 knots and 10 knots, respectively

The Development of the "Big-Gun Ship"

How the Navies of the World Have Adopted the Center-line Position for the Heavy Guns

By Blue Jacket

WITHOUT doubt the "Mother" of all the present battleships in the world was the "U. S. S. Monitor"; for in this small ship was first used the turret that changed the plans of the navies of the world. And this was the first "All-big-gun ship". But at about the same time that this ship was built, another ship was fitted out that more nearly resembles in design the war ships of to-day: the armored turret ship "Roanoke," which had been built as a steam frigate, and to meet the powerful iron-clad ram "Virginia" fittting out at Norfolk, was cut down, and fitted with three turrets each to mount two guns of what was then the largest caliber in the U. S. Navy, the 15-inch smooth bore. Evidently this ship was not well liked, for she was struck off the Navy list soon after 1865, and no other ship of similar plan was laid down. But among the earlier battleships of the German navy the "Worth" class of four ships appears, mounting six 11-inch in three turrets all on the center line. At about the same time four ships of the "Sinope" class were built for Russia, mounting six 12-inch guns in three "barbettes," of which two were forward and one aft; but the current practice in nearly all navies was to mount but four big guns, and usually these were mounted on the center line. Several of the earlier ships of the French navy mounted two guns of 13 inches singly forward and aft, and two of about 10 inches, one on each beam; and the "Pelayo" of the Spanish navy was of this type.

So far as I have been able to learn, the first suggestion for the emplacing of more than six guns of large caliber in the battery of a warship, was published in Jane's "Fighting Ships," for 1903; and the design was the work of Vice-Admiral Cunerberti (an Italian), and was designated as the "Greater Britain". On a displacement of about 17,000 tons, he proposed to mount twelve 12-inch guns; eight in four two-gun turrets, and four singly in casemate mountings (see plan).

Soon after this, the report of our General Board on the plans for the "Connecticut" class was published, and with it a minority report that expressed disapproval of that plan, and offered three other plans: First, four 12-inch and twenty-two 7-inch; second, four 12-inch and sixteen 8-inch, of which twelve were to be mounted in "twin" turrets and four singly in casemates; third, six 13-inch and six 10-inch to be placed in four three-gun turrets as per plan shown or in the language of the report: "What would seem to be a better battery, mount 12 12-inch guns in the same manner." This report bore the name of the late Rear-Admiral Royal B. Bradford, and the details of the plans were worked out by a number of officers at the Navy Department under his direction. In the drawing this ship is called "United States". No action was taken on this report; and six ships were built with the mixed battery of four 12-inch, eight 8-inch and twelve 7-inch and two smaller ships with less speed and only eight 7-inch (this due to the handicap of size imposed by Congress).

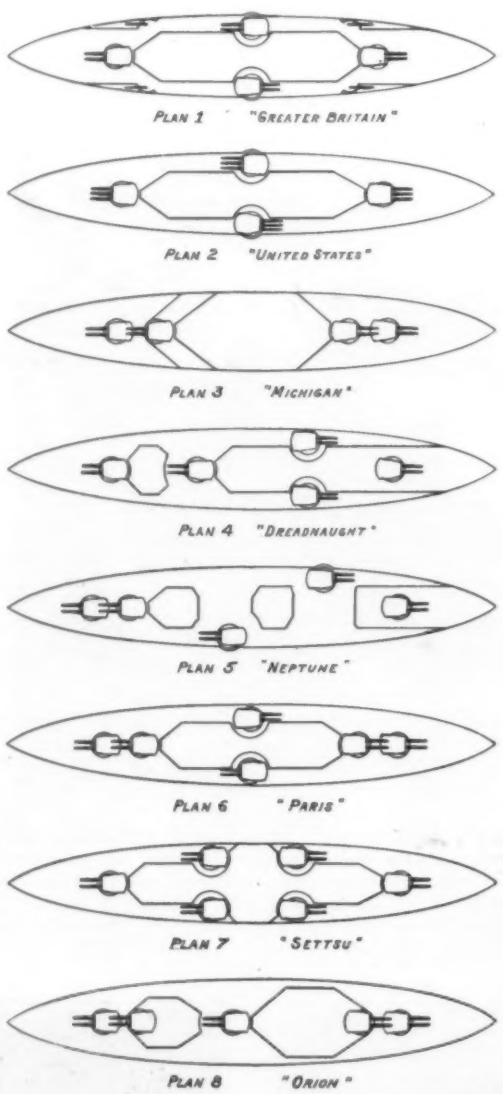
On the suggestion of Rear-Admiral Hitchborn, experiments were conducted which proved that it was safe and practical to fire a gun of 12-inch caliber over the roof of a turret; and the two battleships called for in 1905 were designed to carry eight 12-inch all on the center line. (See plan.) These ships of 16,000 tons and 18 knots, were named "Michigan" and "South Carolina" and were the first all-big-gun-ships to be laid down. But the "Dreadnought" laid down a few months later and completed in the remarkable time of about thirteen months, was placed in active service ahead of them, and so gave her name to the class of big-gun ships. (See plan.) The "Michigan" with her eight guns had a broadside fully equal to this ten-gun ship, and in fact a better all around fire.

England built six more of this design, and three that by "Diagonal" emplacement, were able to secure greater arcs of fire. In fact the "Neptune" could bear all ten guns over a reasonable zone on each beam; (see plan). Four battle-cruisers of the "Invincible" type, but with only eight guns, were built; and in 1909 England adopted the all center line plan for the "Orion" and has held to it since, so far as known.

Brasil laid down two ships in 1907 with four center line turrets and one on each beam; and France followed in 1910 with four of the "Paris" class. The "Nassau" and "Helgoland" classes of the German navy, and the "Settsu" class of the navy of Japan mount 12 heavy guns as per plan; and some of the German battle-cruisers have the diagonal emplacement, but the latest ships of both of these navies are center-line ships. Diagonal emplacement is also found in the ships of Argentina and Spain. Both Italy and Russia laid down ships in 1909 to mount twelve 12-inch guns in four three-gun turrets all on the center line and failed to provide for end on fire for Nos. 2 and 3 turrets, but two years later Italy adopted the "upper and lower level" plan with 13 guns; three three-gun turrets and two two-gun turrets. Austria in 1910 and 1912 laid down four ships to carry twelve 12-inch in four triple turrets, upper and lower level, after the "Michigan" plan.

The first advance in caliber from the 12-inch came in the "Orion" in 1909 mounting ten 13.5-inch, to be followed by our "New York" and "Texas" with ten 14-inch. Then the "Queen Elizabeth" class with eight 15-inch. Our later battleships will mount the 16-inch guns exclusively and the future is hard to guess. In 1914 France laid down the five ships of the "Flandres" class, to carry twelve 13.4-inch in three four-gun turrets; and her "Lyons" class are booked to mount sixteen 13.4-inch in four turrets. The "Flandres" class seems to have a fair arc on each side for the middle turret, but the amount of whip that one of the outer guns will give cannot fail to have an effect on the accuracy of the other guns. Perhaps they have found some method of overcoming this.

But it would appear that Admiral White of the



Various schemes which have been tried out for placing a multiplicity of big guns on a battleship

English navy was correct in his view that the "Michigan" was the logical type; for nearly all of the latest ships of all navies have been built after that design; with more or less modification. And the armor distribution of all of the new ships seems to follow the "Michigan" more than the "Dreadnought," and it is in speed alone that the radical advance has been made. Every ship built at this time is a compromise, for it is not possible to make the same ship the fastest, the heaviest armed, the heaviest armored, and give that ship the greatest cruising radius. The nation that decides on the most perfect compromise will have a large advantage.

Electro-Therapeutics

By Genevieve Grandcourt

IN the early summer of 1916, it was demonstrated to the satisfaction of the French medico-military authorities, that from 10,000 to 15,000 soldiers, lately recommended for retirement on pensions had been so far restored by a new electrical treatment, as to be eligible once more for active service.

These men were from all classes, officers and privates. There were whites from the various provinces of France, and blacks from Morocco and Algiers. Now, was found one who testified to having been freed of a functional trouble of 16 months' duration; now, an acrobat gave evidence by hanging from a horizontal bar by the arm that had been helpless. They who had become deaf-and-dumb, suddenly heard and spoke. Even ailments diagnosed as paralytic, added to the puzzle of electricity's power.

The method of administering—devised by the chief of the Neurological Department of the 9th Army Region, Major-Doctor Clovis Vincent—was to apply tampon-conductors dipped in salt-water, to the fore-arm of the patient, and send into the body for several seconds (three or four), a galvanic current of 30 milliamperes. The faradic current was tried with similar results, Dr. Vincent making the initial experiments on himself.

The experience is described as a stiffening of the frame, followed by sensations (growing in intensity) of prickings, shooting pains, burning, etc., and toward the end, rheumatic agonies and violent tooth-ache. In the cases of stout men, the flesh seem to afford a protecting-pad against the electric current and diminish the suffering, which was, however, very great in those of nervous temperament whose natural sensibility was aggravated by illness or by wounds.

Gradually, accounts of the suffering entailed grew into a legend of horror. Soldiers, here and there, relying upon their rights as citizens, refused to be (as they said) "torpedoed." Several were sentenced to two years' imprisonment as insubordinates, while the pensions granted others were reduced. Discussion became lively in government, medical, legal and newspaper circles, as with the public generally. Every man has the right to refuse a surgical operation. How far was the individual, especially after having lost his health in his country's service, to be submerged in the principle which regards him as a unit in the country's defense? Dr. Eugene Doyen, for one, went so far as to express the opinion that these cures could not possibly be permanent, that it was ridiculous to suppose that when there was an injury to the nerves, as in paralysis, the electrical treatment could be effective, and that it was subjecting the defenders of France to needless torture.

Dr. Vincent now explained that the cure covered only special cases—that of men who, though not simulating their illnesses or their injuries, had the so-called "hysteric" taint. In other words, they lacked, medically speaking, the power to summon their wills. The cure, *in its effects*, was psychic. The example was cited of a soldier who admitted being restored after having been "torpedoed with sufficient force to start a street-car."

As a result of further investigation, the Medical Society of the Paris Hospitals voted confidence in Dr. Vincent, stating that the results obtained by him must be regarded as remarkable; that the several members of the Society considered the treatment absolutely inoffensive and would not hesitate to employ it for members of their own family. In fine, the electrical technique, as outlined above, is now in use in all the neurological departments of the French army, and the soldier for whom it is prescribed, has not the option of rejecting it.

It was the case of a private, Baptise Deschamps, which resulted in a thorough threshing out of the matter before a military council, and incidentally brought interesting facts to the notice of the public.

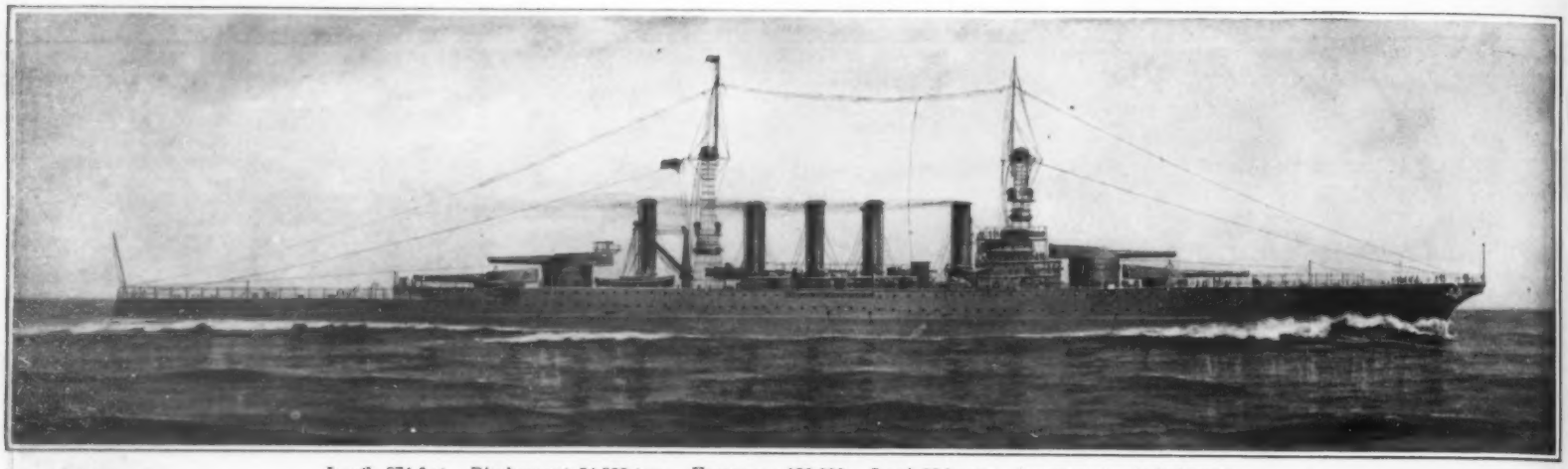
During the maneuvers at the battle of the Yser, October, 1915, Deschamps fell from a considerable height into a ditch, sustaining such severe injuries that though treated in various military hospitals for the succeeding ten months, he was finally pronounced incurable and recommended for retirement on a pension. His trouble was stated to be one of "post-traumatic deformation of the vertebral column." The man walked with difficulty on two short canes, being bent over at a right angle and nearly to the ground, presenting an appearance of hopeless disability.

What was the surprise of all concerned, to learn that it was this man, who on being "torpedoed" by Dr. Vincent, suddenly drew himself up to his full height, and wrestled with the doctor for twenty minutes with all the vigor of an able-bodied man.

On being brought before the court-martial charged with "violence against a superior," he testified that the pain inflicted upon him was so great that he was unconscious of what he did. What the doctor did, however, was to call everyone's attention to the facts which aroused unusual interest in the new method of treatment.

Displacement, 27,000 tons. *Speed*, 21.5. *Armament*, Ten 14-inch, twenty-one 5-inch guns. *Torpedo tubes*, four 21-inch

THE "NEW YORK" MAKING 21.5 KNOTS ON HER TRIAL TRIP



Length, 874 feet. *Displacement*, 34,800 tons. *Horsepower*, 180 000. *Speed*, 35 knots. *Armament*, ten 14-inch guns

OFFICIAL SKETCH OF THE NEW BATTLE-CRUISERS

A Grave Military Defect in our Battle-Cruisers

Ships That May Find Themselves Too Slow for Battle-Cruisers, Too Lightly Armed for Battleships

A WARSHIP is built to fight and everything in her structure, from stem to stern, and from keel to main truck, should be designed for that supreme moment when she casts loose her guns and begins to give and take the terrific blows of a modern battle.

The ideal warship represents a compromise of many desirable qualities, a few of which are absolutely essential, and the rest of relatively minor importance.

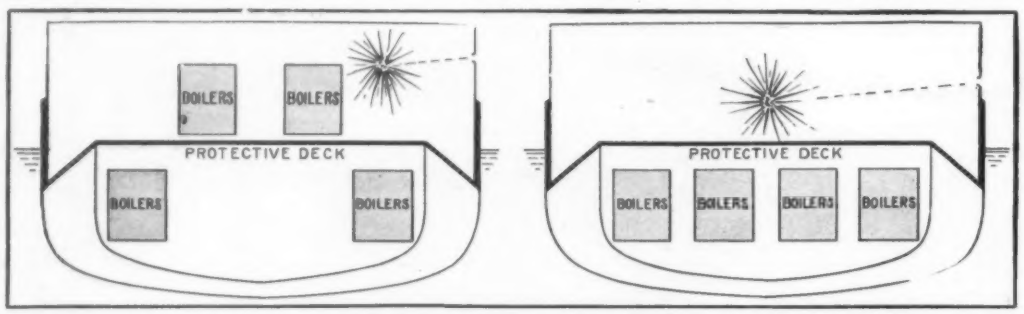
The three major requirements for the ordeal of battle—the three elements which are essential if she is to pass successfully through a modern sea-fight—are her flotation, her motive-power and her gun-power. She must remain afloat, she must be capable of controlled movement in any desired direction, and she must be able to deliver a powerful and accurate fire against the enemy.

Now it goes without saying that these three military considerations should dominate the whole design of the ship; and when the naval constructor and the naval engineer are working together on a new design, they should lay it down as a fundamental principle for their guidance, that no one of these great military postulates should be violated.

Most unfortunately, in getting out the designs for our great 35-knot battle-cruisers, the two Bureaus concerned have so far violated the second of what we have called the three great military requirements, as to place one-half of the boiler plant above the water-line, that is to say, above the protective deck, where it would be liable to be shot away at the very opening of an attack.

During the past half century of warship design, there has existed an inviolable rule, which has never until now been broken, that all the vitals of a ship, her magazines, boilers, engines and steering gear, should be placed below the water-line and covered in by a heavy steel protective deck. These elements are known as the "vitals," and they are well named, since they are vital, both to the existence and the proper functioning of the ship in the hour of battle. If the magazines should be struck, the ship is swept out of existence, as were three of Admiral Beatty's cruisers in the Jutland fight; if the steering gear is disabled, the ship will run amuck among the other ships of its own line, as did the flagship "Czarevitch" in the sortie from Port Arthur, or she may take a sheer over towards the enemy's lines and come under concentrated fire, as did the British "Warspite" in the battle of Jutland; if her motive-power is disabled she will lose speed, drop out of line and become an easy target for the torpedo as happened to the "Bleucher" in the fight of the Dogger Bank.

Now the placing of a part of the motive-power of a battleship above water and its destruction with a consequent loss of speed, would be a serious, but not necessarily a fatal, injury; for her speed is somewhat secondary to her gun-power and heavy defensive armor; but to cripple the speed of a battle-cruiser is to rob the ship of that very quality for which she was built. The loss of these above-water boilers in our ships would cut the speed down from 35 to 29 knots, and this loss would probably occur in the early stages of an engagement. Why is the Department putting this enormous total of 180,000 horse-power into these ships and increasing their size until it equals that of the largest trans-Atlantic liner? They are doing it in order to secure the difference of speed between 29 knots, which is the average speed of existing battle-cruisers, and 35 knots, which will be the least speed of the new foreign battle-cruisers which will be afloat when these great ships go into commission. That extra 6 knots of speed is the very *raison d'etre* of these great ships, and to design them with the extra boilers which are to give them this speed, placed in such a position that they are liable to be destroyed by the first successful salvos of the enemy, is to rob these fine vessels of their value even before they shall have left the building ways.



These sketches of a typical cruiser show the exposed position of boilers, if electric drive is used, and the complete protection secured by the use of geared drive

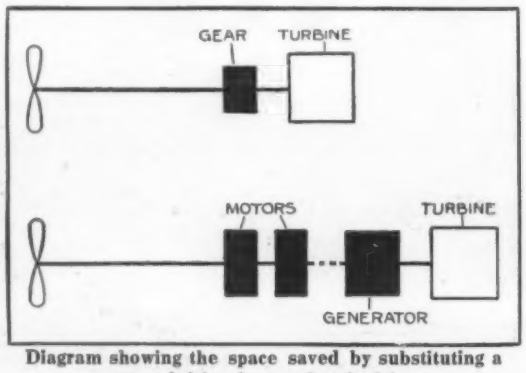
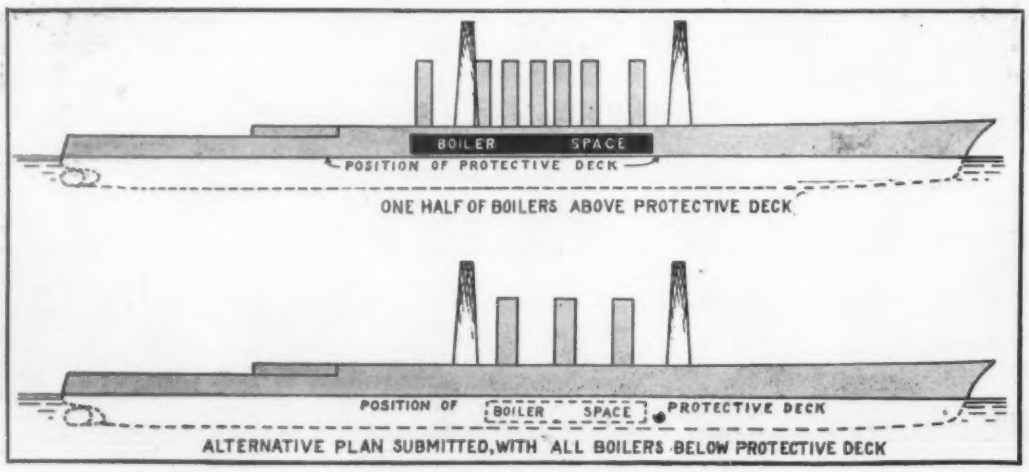


Diagram showing the space saved by substituting a geared drive for an electric drive



These diagrams indicate the conspicuous target offered by seven smokestacks, when the enemy is forward of or abaft the beam

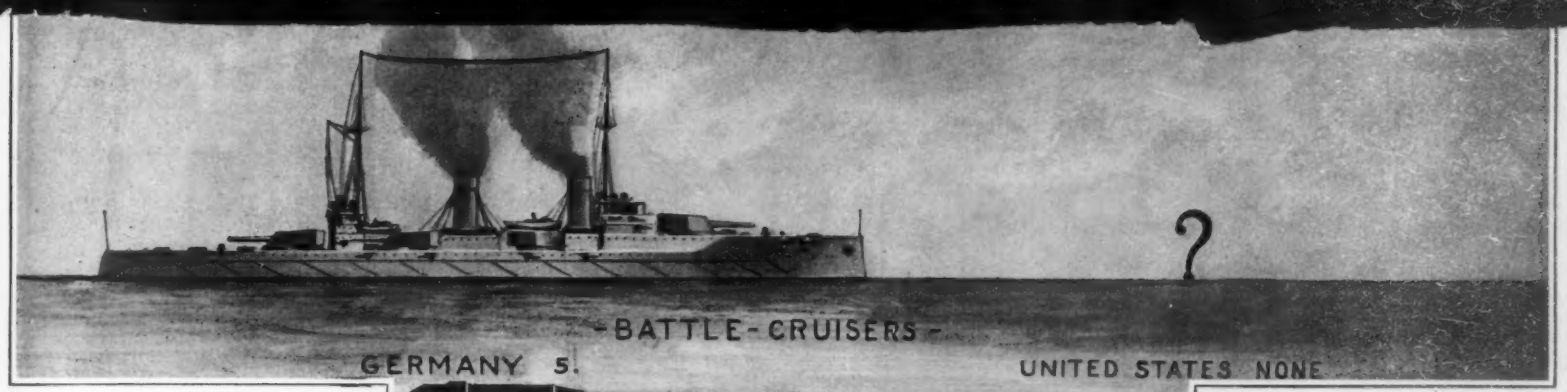
The question which at once presents itself to the mind of a line officer, that is, the man who might have to command one of these ships, is, for what possible reason were these boilers placed in this exposed position? The answer is that the system of electrical propulsion, proposed by Chief Engineer Griffin, is so bulky and occupies so much space, that there was nothing for it but to place one-half of the boilers above the protective deck.

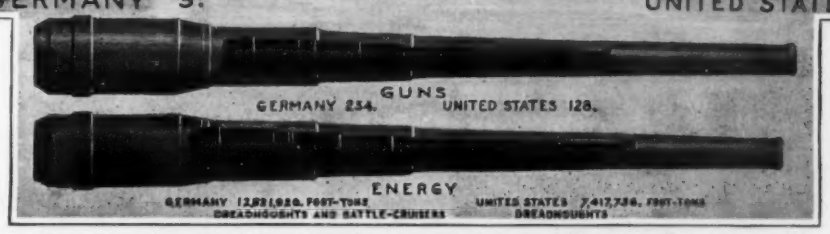
In order to explain in a simple way why electric propulsion demands so much space, we insert the accompanying diagram showing the two systems of drive, which are proposed for use in the ships.

When the steam turbine was first introduced for ship propulsion it showed a low efficiency. This was due to the fact that, for high efficiency, the turbine must be run at a high speed of revolution and the propeller at a relatively low speed. This called for the interposition of some form of speed reduction device between the turbine and the propeller; and some six years ago the Navy Department decided to investigate two forms of reduction, one electrical and the other mechanical, which had been developed in this country. So they took two new colliers of 7,000 horse-power each, and placed in one, the "Neptune," a mechanical reduction gear, invented by a former naval engineer, Mr. McAlpin and the late Chief Engineer Melville, and in the other collier, the "Jupiter," they placed an electrical reduction gear, which had been developed by one of our electrical companies. Both of these were American developments, and each was given a thorough trial.

Unfortunately, the manufacturer vitiated the results in the "Neptune" by designing a new type of turbine, which unfortunately for his gear, proved to be very uneconomical. The "Jupiter" installation used a turbine of standard and well-approved type, and the ship, after very extended trials, proved to be a great success. After some preliminary trouble with the

(*Continued on page 247*)





The relative lengths of the ships show the relative strength in dreadnoughts, and in the number of guns and the aggregate gun energy

A COMPARISON of the strength of the German and American navies is necessarily vitiated by the fact that nobody outside of Germany knows exactly how many ships she has in commission at the present time. Undoubtedly she has added to her fleet since the war began; on the other hand, she has had heavy losses. The best we can claim for the present comparison is that it is based upon carefully considered probabilities.

It must be understood at the outset that the pictorial comparison on this page includes only capital ships—dreadnoughts, battleships, battle-cruisers and predreadnought battleships, and it includes only such vessels as have been completed and placed in commission. Moreover, the comparison is made on a scale of water-line length, and not on a basis of displacement.

As regards new construction, we have assumed that Germany has completed all of the capital ships which were under construction and authorized, when the war broke out. We know that Great Britain has done this, for the fact has been more than once announced officially by the British Admiralty. Presumably Germany has done the same, although only a part of these new ships appears to have been present at the battle of Jutland.

As regards the reduction to be made for losses, the evidence is conflicting. After the battle of Jutland, the Germans claimed that they had lost only two capital ships, the battle-cruiser "Lutzow" and the pre-dreadnought "Pommern." Admiral Jellico, in his official report of the battle, claimed that three dreadnoughts were actually seen to sink during the fight, and that three others were listing so badly that it was believed they must have sunk before they reached a home port.

In order to forestall the flood of protests which would reach this office if we accepted the British estimate of German losses, or even if we accepted a compromise between the English and German estimates, we will take the statement of the German Admiralty at its face value and debit Germany with the loss of only two capital ships. On this understanding then, we find that of dreadnought battleships Ger-

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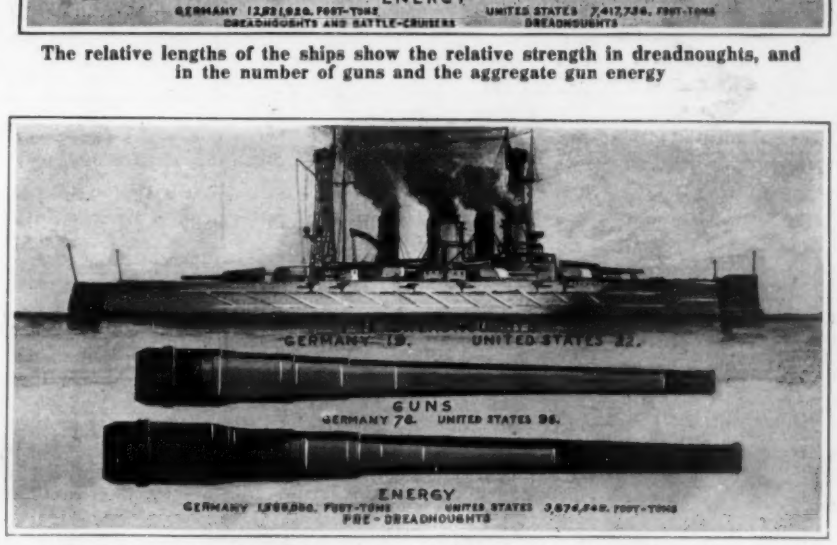
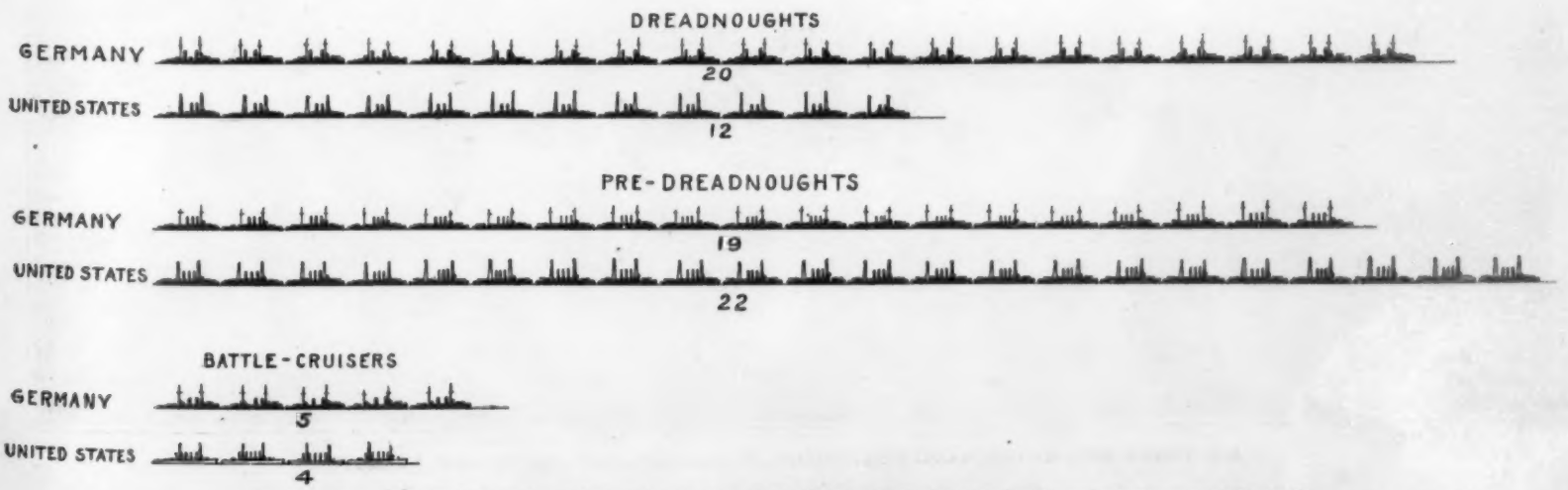
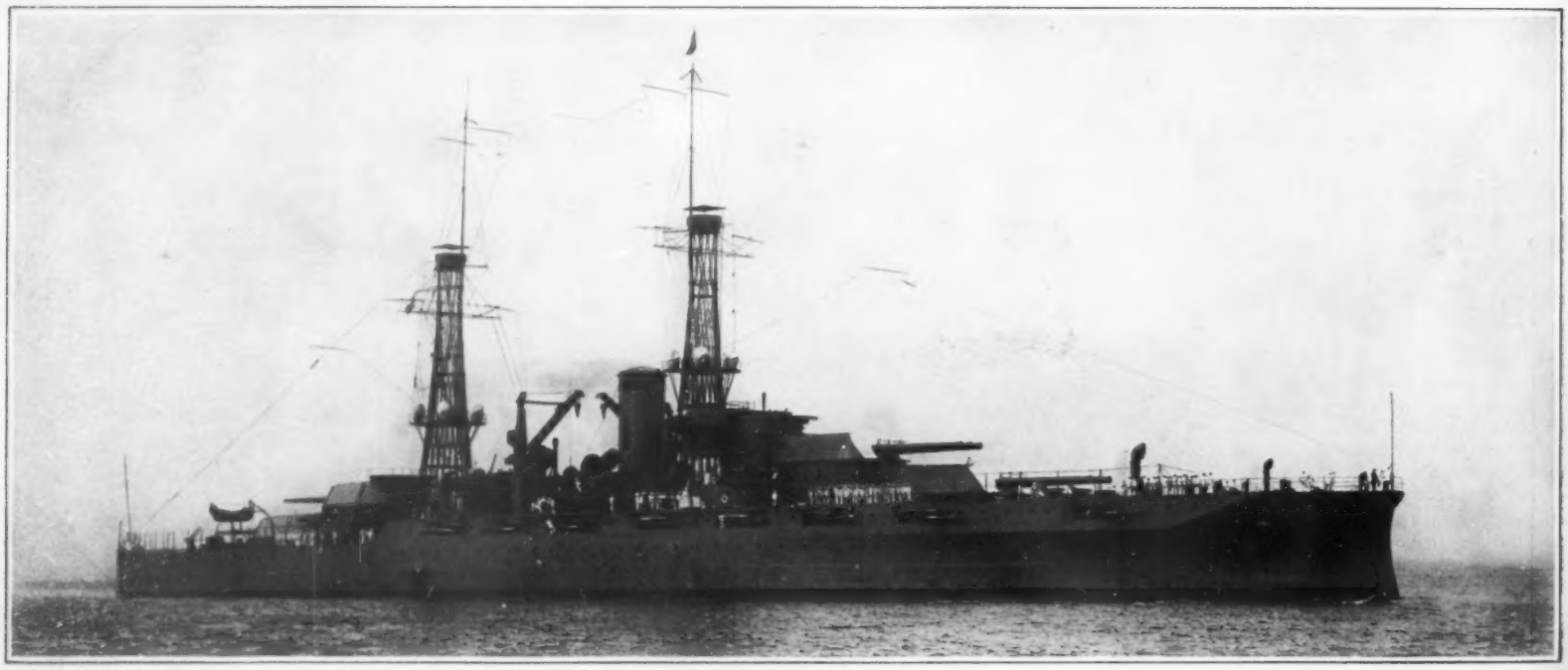


Relative strength in the number of pre-dreadnoughts, in the number of guns, and in the gun energy shown by length of guns and ships

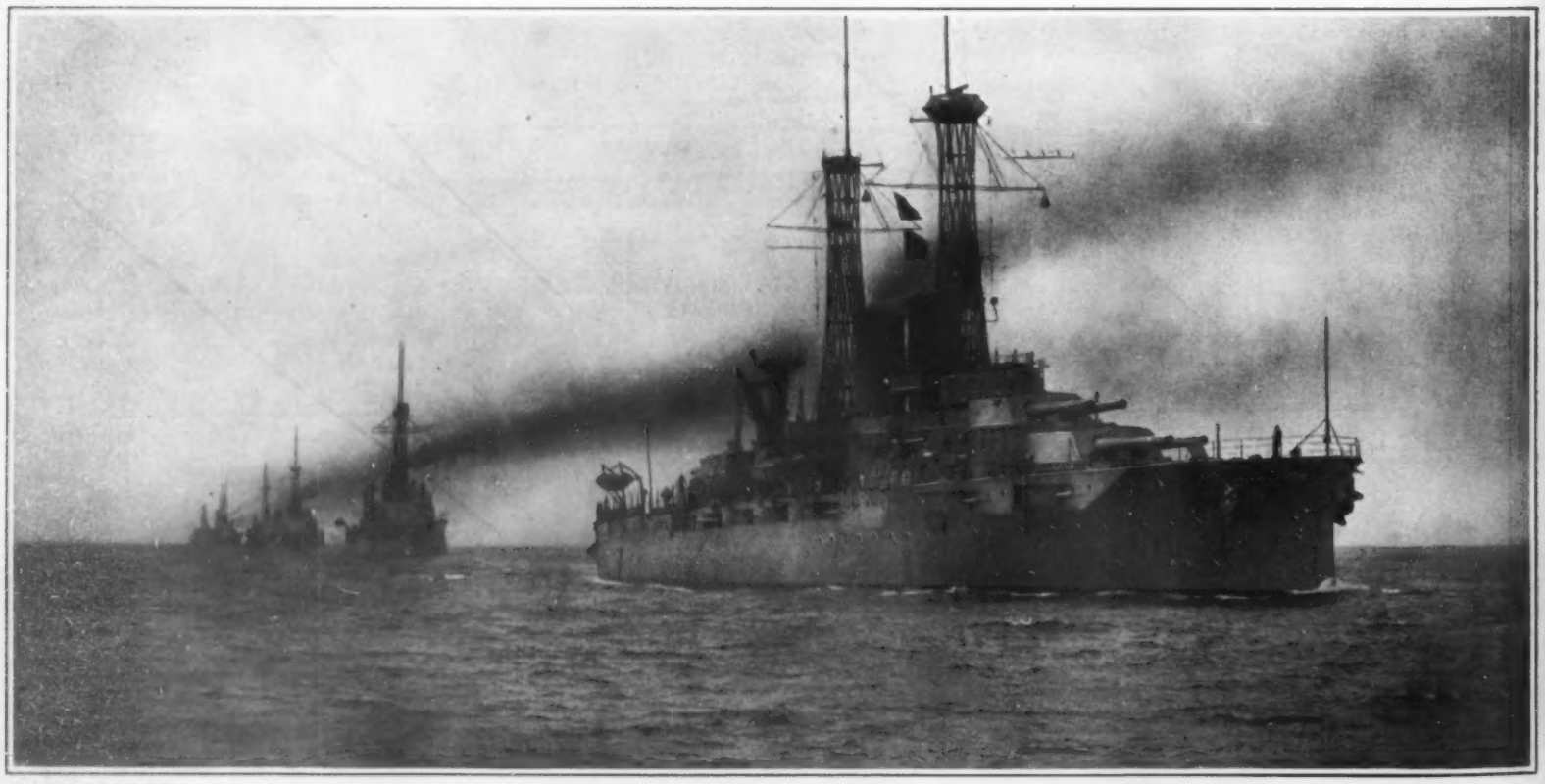


Graphic view of the United States and German fleets. Note that the United States battle-cruisers have yet to be built



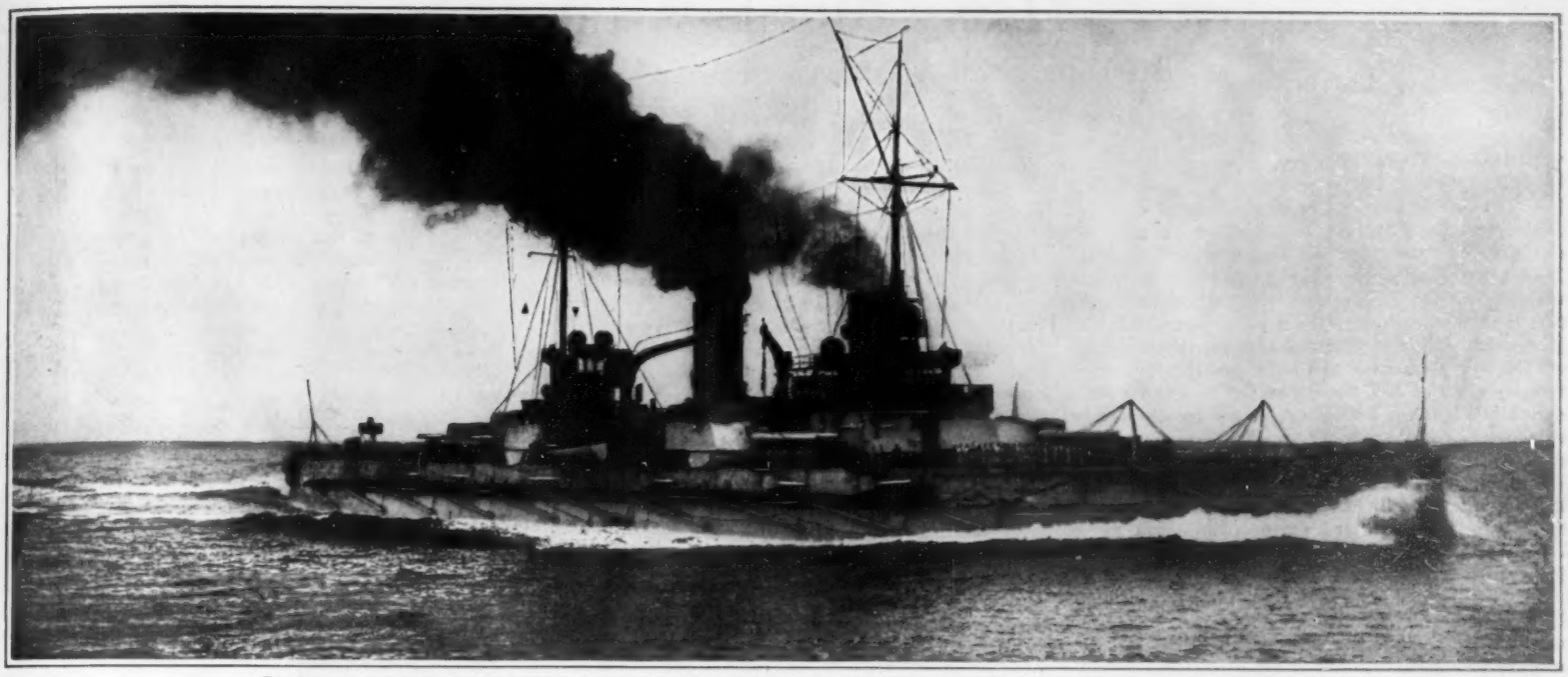
Displacement, 31,400 tons. *Speed*, 21 knots. *Armor:* belt 13½-in., turrets 18-in. *Guns:* twelve 14-in, twenty-two 5-in. *Torpedo tubes*, 4.

BATTLESHIP "PENNSYLVANIA"



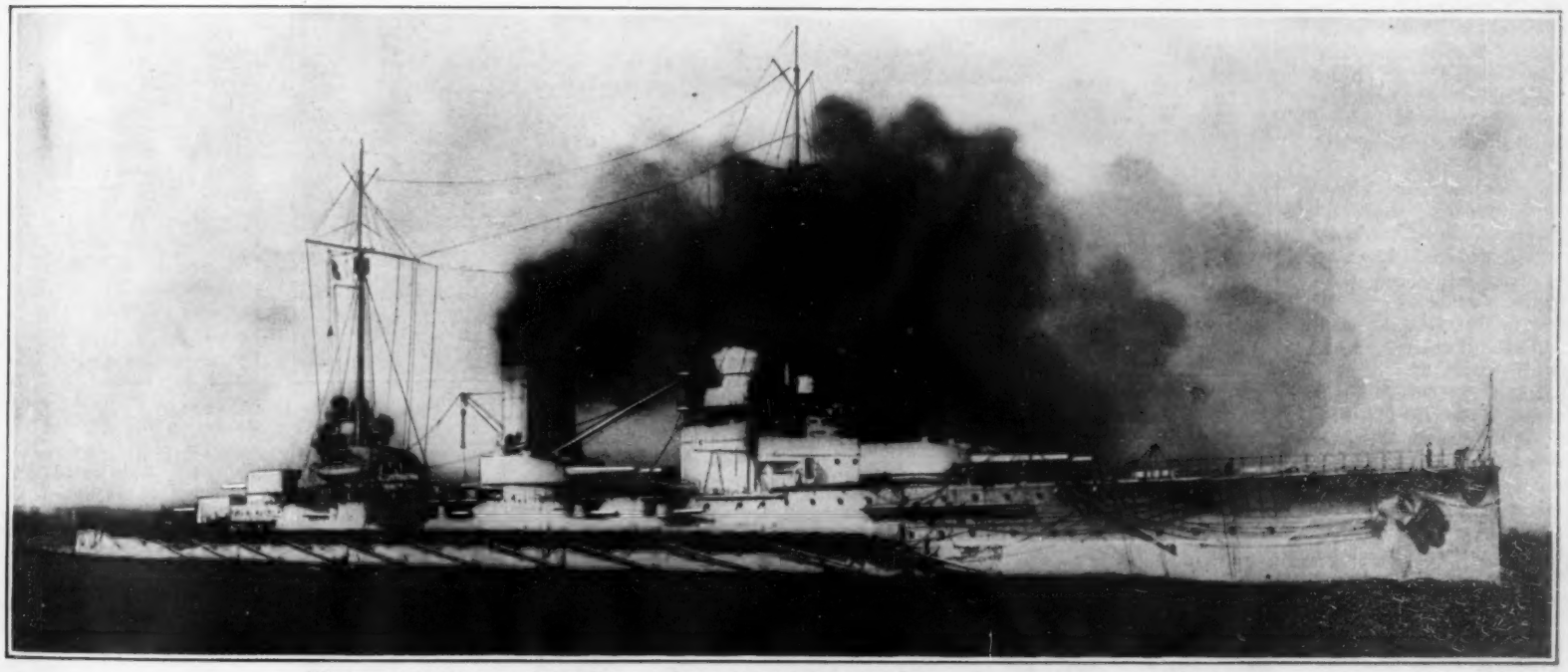
A DIVISION OF DREADNOUGHTS STEAMING IN COLUMN AND LED BY THE "TEXAS"

SOME CAPITAL SHIPS OF THE U. S. NAVY



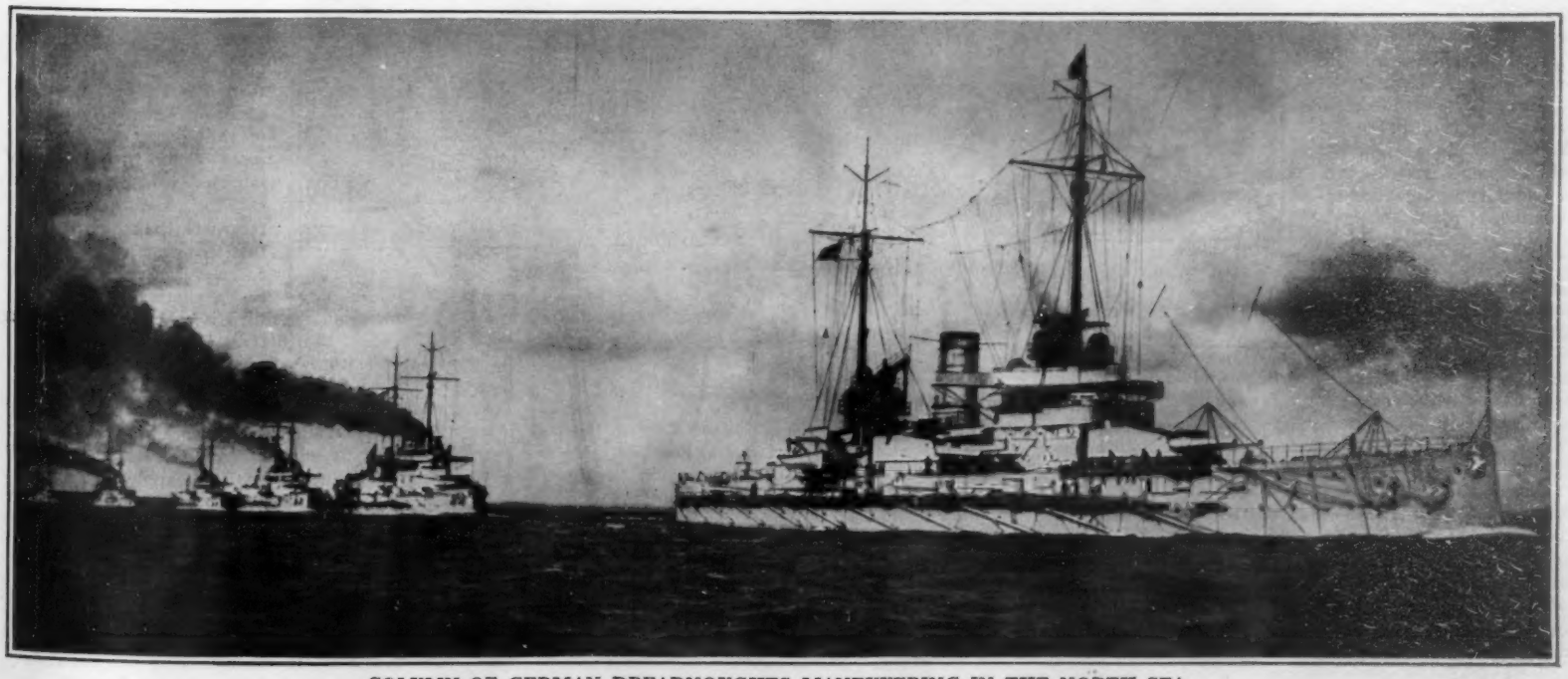
Displacement, 19,000 tons. *Speed,* 20.5. *Armor:* belt and barbettes 11½ inch. *Guns:* twelve 11-inch, twelve 6-inch. *Torpedo tubes,* 6

GERMAN DREADNOUGHT "WESTFALEN"



Displacement, 23,000 tons. *Speed,* 28 knots. *Armor:* 11-inch belt: 10-inch turrets. *Guns:* ten 11-inch. *Torpedo tubes,* 4

GERMAN BATTLE-CRUISER "MOLTKE"



COLUMN OF GERMAN DREADNOUGHTS MANEUVERING IN THE NORTH SEA

SOME CAPITAL SHIPS OF THE GERMAN NAVY

Heavy Mobile Artillery

Its Value as an Asset for Defense in the United States

By Major C. E. Kilbourne, General Staff Corps, U. S. Army

THE use in Europe of heavy ordnance ranging from 9.2 to 16-inch caliber and throwing projectiles of from 400 to 2,000 pounds in weight, loaded with high explosive bursting charges, to a distance varying from six to twenty miles is too well known to need comment. These heavy guns were designed by the Teutonic powers originally for the purpose of destroying the permanent land fortifications in general use on European frontiers. Subsequently the Central powers increased the mobility of their heavy ordnance and have used it with preponderating effect in field operations. The Allied powers, especially France, and England, were driven to develop ordnance of equal power for use, first, in defense, and, latterly, in offensive operations.

In the United States the feeling against war is so great that it is idle to dwell upon anything relating to offensive operations. So firmly are our people wedded to the idea of defense that neither in public writings nor addresses do we ever hear of the offensive, though it is a known military axiom that the *best* defense consists in assuming the offensive at every opportunity.

Following the custom, I shall consider in this article only the defensive power of heavy movable ordnance and the importance of its development in addition to the artillery with which our Army is now supplied.

Our coast fortifications were designed: first—to protect the coast cities and anchorages, naval bases, factories and other utilities from bombardment; second, to prevent the occupation by an enemy of good harbors as bases for invasion, with many railroad lines radiating into the wealthiest parts of the country; third, to give safe harbor to our own fleet if defeated, in which to refit for further operations; fourth, to cover reasonable water areas to the seaward of our harbors in which our own fleet, emerging, could take up battle formation before coming under destructive fire of a blockading enemy fleet.

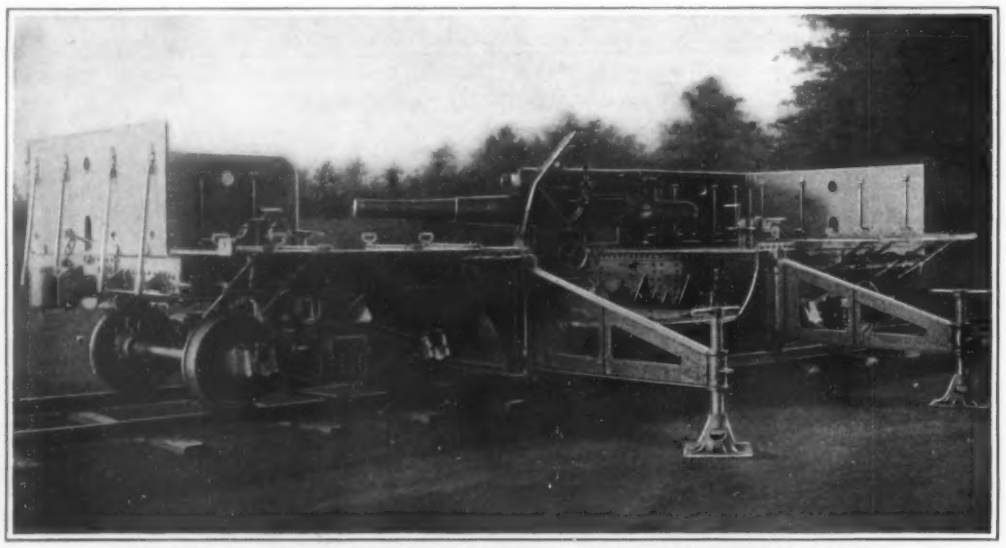
For the foregoing purposes large caliber guns and mortars of great power have been mounted on concrete emplacements and supplied with accessories in the way of searchlights, submarine mines, observing and range finding stations.

Recent developments in naval ordnance have forced us to undertake the modification of our gun carriages and the emplacement of larger caliber, longer range guns, and also more extended installation of fire control systems and searchlights. All of these are necessary if the objects enumerated above are to be accomplished, but the fortifications described have their limitations in that the guns are fixed and are effective to the extreme limit of their ranges and no further. A coast fortification is powerless against a fleet or an army maneuvering a few hundred yards beyond the range of its guns.

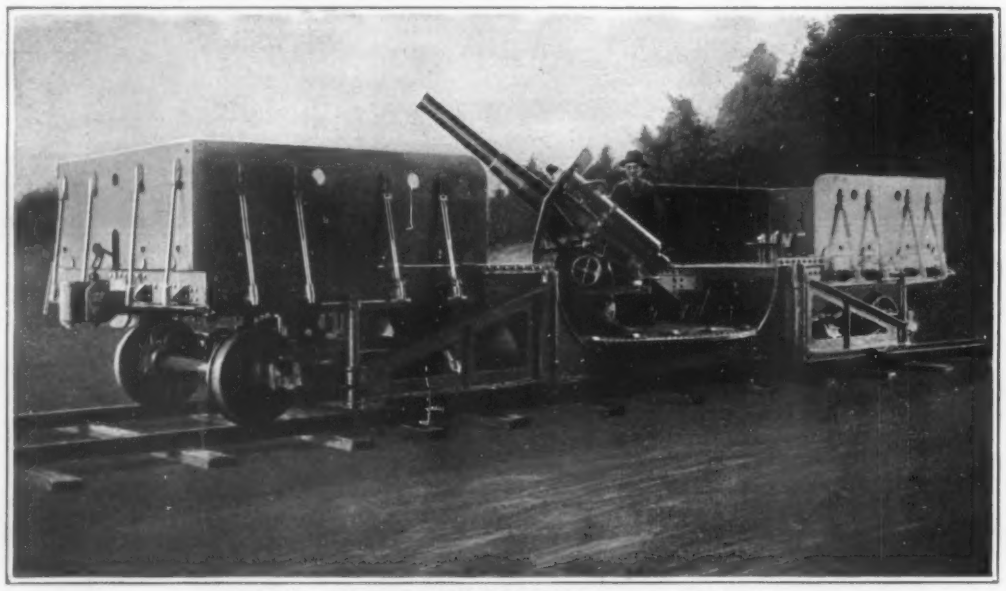
The operations of the Japanese in the Chinese and Russian wars, the attempt of the English on the Gallipoli Peninsula, and our own experience at Santiago de Cuba, show plainly the method which will be pursued always in case important objectives are fortified sufficiently to resist direct naval attack; that is, an army will be landed somewhere beyond the range of the guns, marched to the rear of the fortifications (if practicable), and a combined land and naval attack will be made upon the fortified area. If these operations succeed, the safe harbor and advantageous communications for a base of invasion will be secured.

The above examples all show that the landing of large forces on beach lines is an entirely practical operation and that it can be accomplished even in the face of strong resistance provided the navy of the invading forces can support the landing troops. If the point selected for landing be a reasonably safe harbor the operations are considerably facilitated. There are instances on our own coast line where cities of major strategic importance are flanked by harbors not sufficiently valuable to be fortified, but nevertheless offering fair facilities for the disembarkation of an army. There are instances also where just beyond the range of the seacoast guns are open beaches perfectly practicable for landing operations in good weather. It is for the defense of these harbors and beaches that heavy mobile artillery is especially needed.

It is a peculiar coincidence that on both our eastern and western coasts throughout the more important strategic areas, railroad lines parallel the coast at a very short distance inland making convenient the rapid transportation of such ordnance from place to place.



One of our howitzer cars with brackets extended and jacked up, ready for firing



Railroad how'zer car with 4.7-inch piece, ready for transit

As has been indicated above, landing on the beach or in the small harbor, if resisted, must be supported by the war vessels of the invader, otherwise the troops in small boats and barges will be at the mercy of the field artillery and machine guns of the defenders. Battleships of the predreadnaught class and armored cruisers (such as usually are detailed for convoying purposes) average fourteen small caliber guns to the broad-side. These guns are behind armor invulnerable to ordinary field artillery fire. Half a dozen such vessels lying within a mile of our coast line (as they could in many positions) would deliver something like 500 3- to 6-inch projectiles a minute on any section of the beach line it was proposed to occupy. It can readily be seen that, with such a curtain of fire, the landing of troops, supplies and animals from transports lying close in shore would be an operation of comparative ease and safety.

If, on the other hand, we had transportable artillery of a power which would seriously damage, if not destroy, war vessels of the type named at ranges up to nine miles, the situation would be entirely changed. The transports and supporting warships would be forced to retire to such a distance that small caliber gunfire could no longer reach the shore. At the same time the distance which troops in small boats would have to travel would be multiplied, increasing the time in which our troops could be rushed to the threatened point. The defending field artillery and machine guns could fire upon the boats when they were comparatively close to shore, since at the distance the battleships would lie, they could not support the actual landing even with their turret guns for fear of firing into their own forces.

To complicate the difficulty still further, animals could not swim ashore. The field and siege artillery, usually landed on prepared barges would have to be brought an excessive distance. The time required for landing would be greatly extended with all the danger of a storm interrupting the operations and requiring the transports and other war vessels to take an offing, thus abandoning the troops already landed without the possibility of reinforcement or renewal of supplies until more favorable weather.

The requirements for artillery to accomplish the above results may be stated to be: First, great mobility; second, prompt entry into action as soon as they arrive within range of the enemy's vessels; third, rapid change of position in event of fire from the attacking vessels becoming so accurate as to threaten destruction; fourth, sufficient power to destroy a warship by a single blow if the vital portion of the vessel be struck; fifth, a means of range finding which ensures to the gun the advantages of permanent emplacement and installation.

Though no such type of artillery has been developed in this country there is no doubt that the nation which furnished the inventors of the machine gun, the submarine, the airplane and the turret can solve this comparatively simple problem. If prompt defense is thought necessary, we may always copy European types while improvements are under consideration.

The gun carriage must be an integral part of the railroad car and must permit of being secured by simple operations (not requiring more than two or three minutes) to a base so solid that the gun, after firing, will return to the same position, that is, we must not have to relevel the platform between shots. Such a time consuming operation is all right when firing against land fortifications; the interval between shots is then unimportant due to the fact that the range does not change. But to fire effectively at a swiftly moving target, such as a battleship, the shots must follow each other so rapidly that there will be no material change in range between shots, otherwise the correction for range error observed for one shot will not apply to the next.

Positions fixed in advance for the gun are of importance from another point of view, that is, the location of observing stations for the accurate control of fire may be determined in advance and a plotting board prepared so that the gun may open accurate fire immediately on getting into action. This is necessary, since its position being evident as soon as it opens fire, the gun must *begin to make hits* before the battleship can determine its range accurately and deliver return fire. To hit first in artillery combat usually means to win.

Where a valuable objective, such as a city, navy yard,

or anchorage is being protected against bombardment, it is necessary that the enemy's ships be kept beyond extreme range, guns and mortars of 16-inch caliber are necessary. But such a condition does not obtain for open beaches nor for harbors of minor importance where projectiles falling beyond the shoreline may do considerable local damage but can have no material effect on the progress of the war. For this reason, the 12-inch gun and the 12-inch mortar already developed and tested for our seacoast service are believed sufficiently powerful for our mobile armament.

Assuming the average belt protection of battleships to be equal to 10 inches of Krupp steel and the deck armor to be 4 inches (which is thicker than most ships have), the perforation curves of the 12-inch gun and mortar of a 30 degree angle of impact show that the gun is capable of sending a projectile into the vitals of a warship up to a range of 6 miles and to perforate casemate armor up to 11 miles, while the mortar projectile will perforate the deck armor between 2½ and 9 miles. It will be observed that the effect of the mortar increases with the range (up to the point where the lighter projectile is used), owing to the fact that the shell falls from a greater height and consequently has a greater striking velocity. These weapons used together have an effect destructive to the average warship at all ranges up to 9 miles.

It is appreciated that the warships can bombard a beach with their turret guns at this range and interfere with the concentration of the defenders. But the number of projectiles would be limited, and the defenders could take cover. The recent experiments at Pensacola prove that even the largest projectiles will not penetrate deeply in beach sand; they very quickly turn and pass out and upward. Some effect would be had, but to quote General Shafter, "A soldier must be in danger sometimes, even in war."

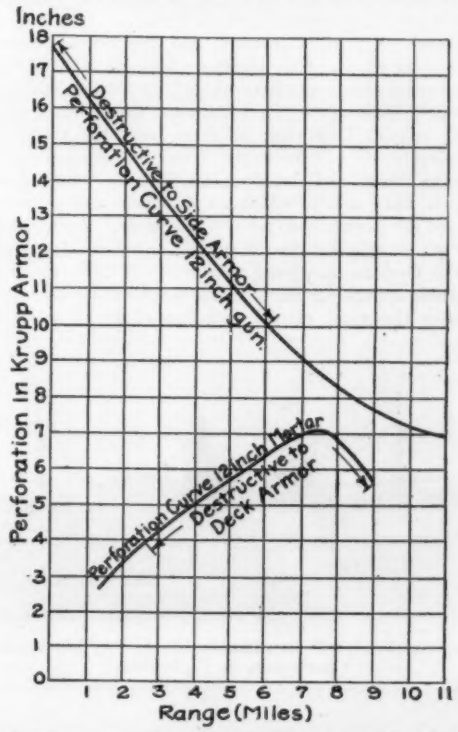
It may be asked why the gun and mortar effect cannot be combined in a howitzer, that is, a weapon which will give both high angle and direct fire. The reason for this is that, in order to have high angle fire from a railroad car, only a short recoil is permissible, and a high velocity gun on a railroad car must have a comparatively long recoil. The carriage for the long recoil gun would have to be very high. This would interfere in crossing covered bridges and also would lessen the stability of the mount on curves of the railroad track. For limited use the howitzers are all right, for all round utility the combination of gun and mortar is better.

A railroad unit should consist of a 12-inch gun on one car, two 12-inch mortars on another, four anti-aircraft guns on a third, an ammunition car for the gun and one for the mortars, a car for the range finding equipment and the necessary cars for the personnel.

Assuming that the enemy, by surprise or by an overwhelming preponderance in artillery, succeeded in forcing a landing in spite of resistence, the heavy mobile artillery would be a strong reinforcement to the defenders during the land campaign. It is certain that artillery of this character could not be landed on a beach, and that, until the invader had secured a harbor with first class docking facilities the defenders would outclass him in ordnance. The progress of the invaders toward their objective by land would be seriously hampered by reason of the fact that they could not establish an open camp within range of such guns and mortars. Their exact location would be known to the defenders who could force them, by artillery fire, to dig in for cover if they ventured within range.

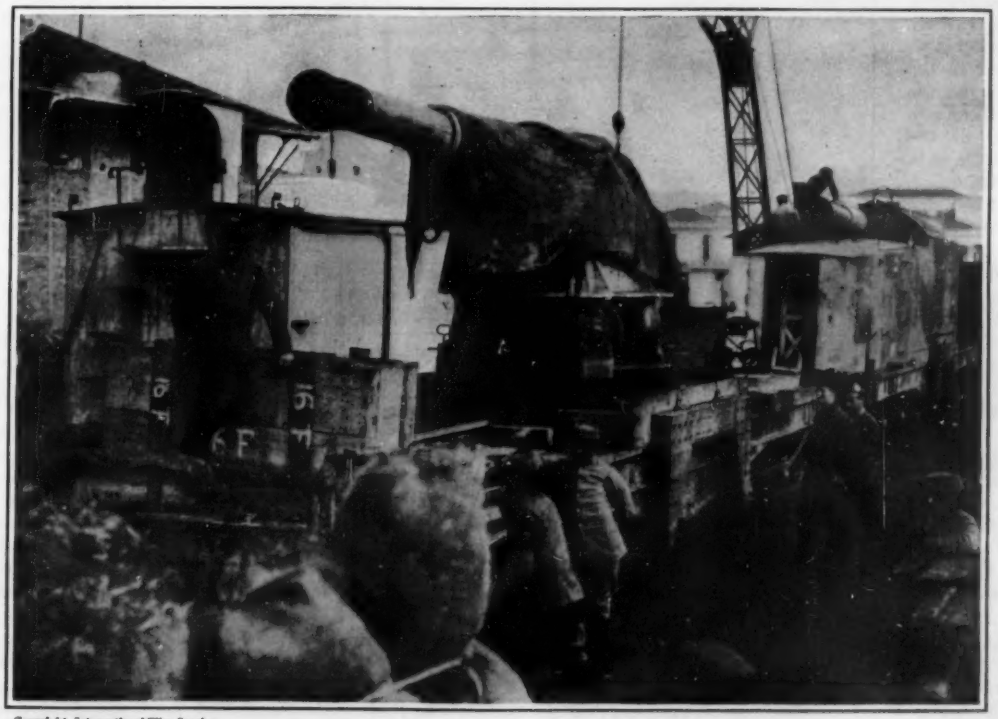
This would mean a march of from nine to eleven miles before they could make an assault upon any defensive line established, exposed to artillery fire to which they could not reply until reaching the effective range of such artillery as they might have been able to land on the beach. No one who has ever taken part in a hard march prior to an engagement will fail to appreciate the enormous advantage to the defenders, who await the assault at rest.

A big naval gun on pedrail mounting, in use on the Austro-Italian front



Perforation curve of a 12-inch gun compared with that of a 12-inch mortar

The sudden fall in effect of the mortar at its extreme range is due to the use of a lighter projectile; its perforating power, however, is greater than the resistance of any protective (armored) deck placed on battleships.



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Mobile artillery used by the British at Salonica

The result would be further delay to the invaders and a greater opportunity for the defenders to concentrate for resistance. In other words, the lesson of Gallipoli, where the defense had time to prepare, and the invaders had finally to retire in spite of initial successes and heroic efforts.

And we must not overlook the moral effect of the possession of such ordnance. We may be certain that, in a country of all nationalities, no fixed fortification can be constructed without its exact strength being known. We may feel certain therefore, that an enemy in contemplating an attack would lay his plans to overcome what he knows is prepared.

But if we had a large number of heavy movable guns and mortars he could not count upon their position. Three days would take them from Portland to Key West. Nor could an enemy count upon unresisted landing at any point on our coast line. By feints he might cause us to deflect the movable artillery to other points than the one selected for attack, but he could never be certain. No nation attacks another without first making plans promising a successful outcome of the venture. Anything tending to render success doubtful will operate to complicate the plan and possibly to prevent the attack entirely. The writer knows of no single preparation which will so strengthen our defensive powers as the provision of powerful, long range, movable artillery.

The Current Supplement

WHILE many new varieties of woods for interior finish and fine cabinet work have been made available of late years, mahogany still maintains its place as one of the best for high-class work that has ever been discovered. In the article on *The Mahogany Tree*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2148, for March 3, 1917, much valuable information is given in relation to this material and its sources, and the article is accompanied by a number of unusually fine photographs. A short note recently appeared in these columns on a paper on *Some Present Day Technochemical Problems*, by Dr. Bacon, Director of the Mellon Institute, but the subject is of such importance that the presentation of the entire paper appears to be desirable, and it will be found in this issue of the SUPPLEMENT. *Trenching Machinery* illustrates and describes some power devices now extensively employed in engineering operations where large quantities of earth must be handled. *Tenacity of Life in Insects* is a short account of the vitality exhibited by a moth which was mounted for a collection. It is accompanied by a photograph of the insect. *Photomicrography for the Amateur* describes a new method of doing this interesting kind of photographic work that is both simple and inexpensive. It is accompanied by a number of explanatory diagrams and specimens of the work produced. *Electrical Treatment of the Wounded* describes recent methods that have been developed during the war in Europe with most gratifying results. An article on *Seaweeds* gives an interesting account of their economic uses and possibilities.

Magnetic Damping of Mercury

THE Bureau of Standards has devised an electromagnetic method of damping waves and other disturbances in mercury in barometers and other measuring instruments. It is expected that this method will be found extremely useful in increasing the accuracy of measurements taken at sea.

The German Merchant Fleet

Ports All Over the World Which Are Giving It Shelter

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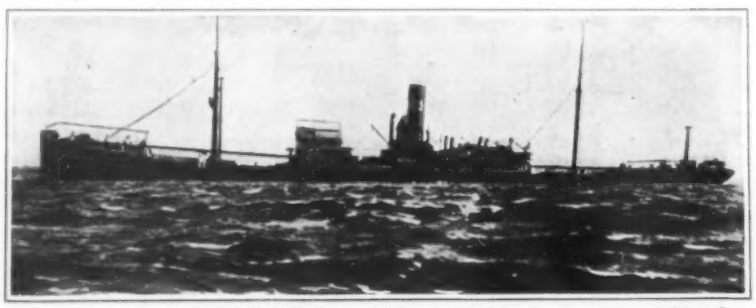
Panoramic view of some of the big German liners lying idle at Hoboken, opposite New York

"WHO, or which, or why, or *what*, is the Ahkoond of Swat?" sang Edward Lear when the death of that native Indian potentate was chronicled in his morning paper. And in the present juncture we are prompted to demand of our readers, "What is Tjilatjap? Where are Caleta Buena and Port Madryn? Is Telok Betong a man or a place? And who, or which, or why, or *what*, is Banjoewangie?"

If we and the big majority of our readers are incapable of answering these queries without the aid of a collection of ponderous reference volumes, it appears that the race of German sea captains in August, 1914, was less ignorant. For the above jaw-breakers are not the names of a family of Indian potentates, or of a new series of breakfast foods, neither are they a meaningless jumble of letters picked out at random; they are merely some of the neutral ports in South America and the Pacific to which those captains turned for a haven of refuge from the sea-sweeping British cruisers when England's entry into the war came over the wireless.

At the present time, with the possibility of nations heretofore neutral becoming involved in the war, a close survey of the location and status of Germany's great merchant fleet becomes more than ever a matter of the greatest concern. When at the outbreak of hostilities German passenger and freight vessels remained at their docks or scurried madly for the nearest neutral harbor, the world smiled and nodded its head over the sagacity of the move and the evident foresight which had made it possible. As the conflict went on we commented upon one phase or another of the situation of these boats, we pointed to the spectacle afforded at the Hoboken piers by the serried rank of ships that never sailed, and through one incident after another we became well acquainted with the presence of this idle fleet upon our shores.

Perhaps the exact status of these vessels, however, has eluded us, through the persistence of our news organs in referring to them as the "interned German fleet." Interned of course they are not, unless we are to give to this word a significance not properly its own; for they are entirely free to take on cargo and passengers at any time and clear for any port in the world. They do not do this simply because the British fleet would make their safe arrival impossible. But so far as the presence of any German merchantman in any neutral port is concerned, she is there of her own volition; and official shipping registers recognize the correct state of affairs by reporting these craft "in port, New York," "in port, Callao," precisely as they report a ship which is in port temporarily, discharging or loading or awaiting a cargo. Technically and legally these vessels are truly neither more nor less than "in port."



German steamer "Liebenfels," presumably scuttled by her master, sinking in Charleston, S. C., harbor

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"Prince Joachim," "Prince Eitel Friederick," "Konig Wilhelm II," "Hamburg" and "Allemannia" (from left to right) at 135th St., New York

If we or any other neutral power should be forced into war on the side of Germany's enemies, however, this situation might well be changed. To be sure, international law and specific treaty cover the matter and make appropriation of these ships illegal. They are supposed to be inviolable, to lie unseized and undamaged at their moorings till the end of the war, and to be then returned to their owners. But international law has seemed to count for little in this conflict. Each side accuses the other of violations, and makes these accusations the pretext for further violations. In spite, then, of treaty provisions, in spite even of official declaration that these will be respected, conditions are conceivable under which they would be violated; and the present location of the German merchant fleet becomes of vastly more moment than before. For who can doubt that right now, with only the half-believed promise that we will enter the war if no other possible course is left open to us, Germany considers her ships in Spanish harbors better risks than those in ours, and the ones in the Dutch Colonial ports better even than those under the jurisdiction of Alfonso? The disabling of so many German vessels along our Atlantic coast—from the German viewpoint an obvious and necessary precaution—indicates clearly how the matter is seen in Berlin.

There are at this moment 533 registered German steamships afloat, of an aggregate tonnage of 1,758,585. This includes none of those which have been taken over by the German government and have thus become warships, necessitating their omission from the merchant shipping news. It excludes likewise the commercial tonnage built and building in German yards since August, 1914, and of which no statement can be made beyond the general one that it is very large. Accordingly it does not represent the full present or potential strength of the German merchant marine. But it is the best available approximation to that strength and must serve.

After the most careful collation of every scrap of maritime news, we find that of these, 204 vessels with a tonnage of 663,027, representing 37.7 per cent of the total, are at the present moment under Germany's control; that 56 vessels of 138,691 tons, or 7.9 per cent of the total, are under control of one or another of the Allied Powers; and that the remaining 54.4 per cent, comprising 273 vessels of 956,867 tons, are under the control of nations now neutral. In other words, more than half of Germany's total merchant tonnage is "interned" in neutral ports.

A word or two in explanation of the above division may not be out of place. The vessels grouped as "under German control" are for the most part either big liners and freighters "in port" at Hamburg, Bremen, Antwerp, etc., or else small and medium-sized craft now plying between the German Baltic ports or engaged in the important trade with Scandinavia and Holland. In addition there are six ships at Constantinople, and one each at Smyrna, Alexandretta and Beirut, one at Trieste, and two at Piraeus, which may fairly be looked upon as a friendly port. Finally, there are several vessels at the ports of Dar es Salaam, Lundi and Tanga, in German East Africa.

The vessels classified as "under Allied control" are those which either have been seized upon the high seas or in Allied ports, or else lie in Allied ports as yet unseized. The biggest share of course falls to Portugal, in whose ports 21 German ships were caught when this Republic abandoned its neutrality. These have all been seized regardless of specific treaty provisions, and are now in service under the Portuguese flag. Their tonnage is 51,307—approximately three per cent of Germany's total, and a very considerable nibble, even if Portugal's possession turns out to be a temporary one.

There remains to speak of the 54.4 per cent of the German mercantile fleet which is "in port" in neutral countries. If we will but realize that the serious business of the North German Lloyd and the Hamburg American lies in the South Atlantic and the Pacific, it must be clear that the rather general impression that practically all of this larger half of the German mercantile establishment is in our ports is erroneous. As a matter of fact, of the total "interned" tonnage of 956,867, barely a third—328,648, to be exact, or 34.3 per cent—is in ports flying the flag of Uncle Sam. Brazil alone has nearly half as much; Spain, Chile and the Dutch East Indies each has about a third as much; all South America has nearly a fifth as much again. Indeed, if one has access to a map of the peace-time routes of the big German companies, it will be evident that the ports of the Atlantic coast of South America, the Mediterranean and Canary Island ports of Spain, and those of Java and Sumatra, present, next to New York, Boston and Manila, the most convenient havens of refuge to the boats which were out on their routes on the day of England's war declaration; and it is in these harbors that we find them.

New York, of course, has the biggest share; 24 vessels, representing 7.8 per cent of all Germany's ships, and more than are "interned" under any single flag save that of Brazil, are tied to the docks of our metropolis. This number includes the "Vaterland," longest of all ships, and the "President Grant" and "President Lincoln," both of 11,000-odd tons. Boston, with an average tonnage of practically 7,000 for her six guests—including the "Amerika" of 13,637 tons, the "Cincinnati" of 9,733, and the "Kronpronzessin Cecille," which made herself famous and got herself sued by turning back after having steamed well out to sea with several million dollars in gold in her safe—leads in this respect, although closely pushed by New York, as well as by Philadelphia and Baltimore, with four and three big ships, respectively. Then there is Manila with 12 ships, and Honolulu with seven; and the readers of a popular series of Philippine Islands stories will perhaps learn with surprise that Zamboanga is not a creation of the author's imagination, but is at least enough of a real place to give shelter to a German ship of 1,344 tons. And the United States probably can boast an "interned" ship that is stuck faster in her present location than any other, for she is tied up near Cleveland, and must go out, as she came in, by the Welland Canal or not at all.

(Concluded on page 245)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of SCIENTIFIC AMERICAN.

Of General Interest

CONCRETE TILE FORM.—G. G. CRESS, Benedict, Kan. This invention provides a tile mold having a novel form of expansible shell. It provides novel means whereby the shell of the mold may be locked in operative position while the tile is being formed and means whereby the shell may be quickly expanded to permit removal of the same from the finished tile, the means being also provided whereby the core may be quickly contracted to permit the removal of the same from the finished tile.

HOTBED.—J. NICASTRI, Shore Road, North Beach, L. I., N. Y. The purpose of the invention is to provide certain new and useful improvements in hotbeds whereby the beds can be readily set up of any desired length with a path between for the gardener to walk on for opening and closing the bed and attending to the plants therein.

METHOD OF MANUFACTURING ARTICLES OF SYNTHETIC COMPOSITION.—E. P. NICHOLSON, 932 Birch St., Richmond Hill, L. I., N. Y. In this patent the object of the invention is to eliminate the use of collapsible or sectional cores and substitute therefor a hollow core about which the synthetic material is molded within a mold and which core remains part of the molded article.

POLE STEPS.—C. WINTER, Oskaloosa, Iowa. This invention has reference to stops for transmission line poles or poles for any other purpose, and has for an object the provision of an improved arrangement whereby the step may be quickly applied and removed whenever desired.

SCALE.—G. L. RUSHTON, care of The Fairmount Creamery Co., 12th and Jones Sts., Omaha, Neb. The invention pertains more particularly to scales utilized in the weighing of butter and other products exuding a briny fluid or one otherwise having deteriorative effect on metal, the object being to provide a scale the working parts of which are wholly immersed in oil and covered whereby to prevent the entrance of the deteriorating fluids as well as to effectively cushion and control the movements of the scale parts in order to promote quick reading.

SANITARY CIGARETTE PAPER RECEPTACLE.—J. A. JONES, C. O. ROWE and C. E. JOHNSON, Box 72, Palestine, Tex. An object here is to provide a casing containing a continuous strip of paper and having a hinged cover therefor to which, is pivotally connected a cutting member whereby the paper may be cut to any desired length as the same is withdrawn from the casing.

SIPHON.—N. M. CHANDLER, Woodland, Cal. The invention provides a device especially designed for use with siphons used in transferring liquids from one place to another, as for instance, in the transfer of water from irrigating ditches to the fields to be irrigated. It provides means for attachment to the discharge end of the siphon for sealing the said end during the process of removing the siphon from the water.

DRAWER RACK.—F. BRADY, Middletown, Del. The object here is to connect and arrange the partition plates so that each may move in the direction of its length, for practically its entire length, with respect to the others, and to provide certain means whereby the several plates may be supported in selected adjustment without depending upon the drawer in which they are disposed for such support.

DOVETAIL-LOCKED VENEER.—W. F. KRUEGER, Morgan and 22d Sts., Chicago, Ill. This invention relates to veneered articles, and has to deal more particularly with means for locking a sheet of veneer on the wooden body of the article It provides means for fastening veneer to a wooden base or body in such a manner that dampness or water will have no separating effect on the veneer but rather induce an increased holding action. The engraving shows a vertical section through a portion of the finished article.

LATTICED POLE.—J. ENNIS JENNINGS, Westminster Road, Brooklyn, N. Y. The inventor provides means for connecting metal members to form a structure without the use of bolts; provides a pole constructed to offer the minimum rigidity and resistance in one plane; provides a structure whereby the cost of assembly is reduced; and provides self-locking fastening devices for uniting the members of the structure in service relation.

IMITATION FOOD OR OTHER ARTICLE AND ART OF MAKING THE SAME.—C. JAEGER, 1495 3d Ave., New York, N. Y. This invention relates to the art of reproducing and imitating natural objects such as fruits, vegetables, meats, or the like, or manufactured food products, such as pastry, confects and other articles of manufacture In carrying out the imitation use is made of various ingredients in proportions suitable to the particular purposes for which they are employed.

Hardware and Tools

HOSE COUPLING.—A. G. HUGHES, Box 386, Douglas, Ariz. One of the principal objects of the invention is the provision of an improved hose coupler capable of being readily and quickly coupled and uncoupled without the use of tools, and embodying an improved means of locking the coupler in coupled position.

SKATE HOLDER.—J. H. FERODOWILL, 214 W. Indiana Ave., St. Paul, Minn. In this case the object of the invention is the provision of a skate holder to be used in grinding skate runners, the holder being simple and cheap in construction, and being one which may be conveniently operated under all conditions. There is ample room within the C-shaped grips to include the shoe to which the skate is attached, the arrangement being such that the view of the operator in grinding is not obstructed.

HOSE COUPLING.—C. L. RUSSELL, 247 S. F. St., Tulare, Cal. The invention relates more particularly to a female coupling member, and provides a coupling member which may be used in making a fluid tight joint between hose or other tubular sections, or between a hydrant or a hose, and in such manner as to eliminate the use or necessity of any washers or gaskets.

RAZOR BLADE HOLDER.—R. A. JOHNSTONE, Almyra, Ark. The improvement provides a holder for a detachable blade, wherein an arm of the razor has a socket for the reception of a blade carrier and ejector removably mounted therein and having a clamping device associated therewith for returning the blade in adjusted position.

DISPENSING MATCH HOLDER.—C. H. ODELL, 407 W. 42d St., New York, N. Y. The invention pertains to holders of that type by which matches are dispensed one at a time from a reservoir by the manual operation of a dispensing means. It provides a dispensing device for matches, toothpicks or other articles through the medium of an oscillatory drum that picks up an article from the reservior or hopper and delivers it at the point of discharge.

LOCK.—S. SEGAL, 75 Fulton St., New York, N. Y. The invention provides a lock construction including a keeper adapted to be secured preferably to the door frame and a lock casing carrying a movable bolt having one or more hooks slidable into interlocking engagement with portions of said keeper, the direction of movement of said hooks being transverse to the longitudinal axis of the casing.

CANVAS HOSE COUPLING.—N. B. BRALY, 14 W. Granite St., Butte, Mont. This improvement has reference particularly to a coupling for canvas hose used in mines, and has for an object the provision of an improved structure which is reversible and which may be quickly connected and disconnected at any time.

WOOD WORKING VISE.—A. L. WILSON and F. MCGLINCHY, Box 134, Willoughby, Ohio. The purpose in this case is to provide a woodworking vise arranged to permit its convenient attachment to a bench, saw-horse or other suitable support and adapted to readily clamp and securely hold a piece of work in position for the carpenter or other person to work on.

CLIPPER.—C. E. ARD, 1118 Leighton Ave., Anniston, Ala. This invention provides mechanism adapted for sanitary cutting and removal of hair, and designed also for use in clipping animals, furs, pile goods, and the like, wherein a fixed closed casing of circular form is provided, within which is mounted a rotatable cutter, the casing having means for permitting the contents thereof to be exhausted and having a cutting opening through which the hair is drawn when it is cut, the cutting member coöperating with the edge of the opening as a fixed blade.

AUTOMATIC LOCKING DEVICE.—O. F. ENSIGN and A. J. THUNEMAN, 809 Deatrich St., Defiance, Ohio. In this case the inventor has reference to nut locks, and its object is the provision of a new and improved locking device arranged to automatically and effectively lock a screwed up nut in place on a bolt and to allow unscrewing of the nut in case it is desired to do so.

PLUG TOBACCO CUTTER.—H. H. SCHUTZ, Los Lunas, New Mex. Objects of the invention are to provide a cutter that may be cheaply produced in compact form to include a base plate having an ample area to firmly support thereon a piece of plug tobacco, and also a knife especially adapted to cut a piece from the plug of tobacco.

Heating and Lighting

CANDLE GUARD.—A. SHORROCK, 68 Main St., North Adams, Mass. The guard is arranged to shield surrounding parts against being accidentally set on fire, scorched, carbonized ot otherwise injured Use is made of a skeleton frame having at its base a support for the candle and a tubular guard of wire netting extending within the same frame and attached to the base and top thereof to centrally inclose the candle.

REINFORCED CENTER FRAME FOR BOILER GRATES.—J. MAHON, 261 Star St., New Haven, Conn. The invention relates to the grates of locomotive boilers, stationary boilers and other boilers, and provides a new and reinforced center frame for such grates to prevent the center frame from breaking, warping or cracking with a view to insure long life of the grate and to hold the grate bars in proper position for being shaken whenever required.

CREMATORY.—A. C. FELTON, JR. Address Nye Odorless Crematory Co., Georgia Casualty Bldg., Macon, Ga. An object in this invention is the provision of a garbage crematory in which the burning of the material is accomplished at a minimum expense and in such manner as to completely consume the combustible portions of the material and leaving very little ash.

Household Utilities

ELECTRIC WINDOW FAN.—E. E. HEPSLEY, 2401 Norton Ave., Everett, Wash Mr. Hepsley's invention relates to means for causing a circulation of air in a room or apartment, and the main object thereof is to provide such means within a window frame, which means serve the additional purpose of a closure for said frame when desired.

VENTILATOR.—S. E. LEVEY, 145 New York Ave., Weehawken, P. O., Union Hill, N. J. This invention provides a ventilator that will automatically adjust itself to windows and window frames of different widths and firmly retain itself in the frame, independently of the sash; provides a ventilator which in adjusted position will present no interference with sash cords and pulleys; and provides a ventilator having provision for receiving screen material at a face thereof and having a shutter to effect a complete closure or a partial closure of the ventilator.

SWINGING SANITARY WINDOW CUPBOARD.—F. J. DOWLING, 425 W. 124th St., New York, N. Y. Among the objects of the invention is to provide improved facilities for the storage of milk, meats and other food products in an adjacent window whereby the commodities may be easily placed into the receptacle or cupboard and likewise removed therefrom.

TEA CANISTER.—T. J. BOUREK, care of the Eddy Hotel, Helena, Mont. This improvement provides a canister designed to contain in a sanitary manner, and dispense in various and desired amounts, teas of different grades or kind. It provides a canister having a dispensing apparatus, whereby the desired amount of tea may be drawn from the canister at any time.

GAS BURNING STOVE.—C. A. HARTMANN, 318 E Capitol St., Washington, D. C. The improvement provides a device by means of which the gas may be automatically turned on or cut off when a vessel is placed on a burner or is taken off of it. The device may be applied to an ordinary gas stove without the necessity of dismantling the latter.

ASH RECEPTACLE AND SIFTER.—P. F. QUINN, 1736 Garfield St., Van Nest, Bronx, N. Y. The receptacle is adapted to be placed in proximity to the stove or furnace so that the ashes may be deposited directly thereinto, means being provided to perform the sifting operation in such place and return the unburned coal directly to the stove or furnace. It is practically dust-proof, means being provided to manipulate the shaker from the outside of the receptacle ,the shaking means being adapted for use as a poker, lid lifter and the like.

WATER HEATER.—VAN KING ROBINSON, Gatun, Canal Zone, Panama. An object of the invention is the provision of a heater casing or a main body portion of novel construction adapted to be mounted contiguous to the fire-box of a range, and having connection with a tank for containing the water to be heated, whereby proper circulation is maintained.

SANITARY GARBAGE CAN.—P. Cohen, 719 W. 180th St., New York, N. Y. The more specific object here is to provide a stationary casing having an open front out of which the receptacle tilts, the casing including simple, novel and effective means for tiltably supporting the receptacle and removably holding the same in place.

Machines and Mechanical Devices

SAFETY DRIVE FOR DRILLING MACHINE DRUMS.—A. J. SHARP AND J. O. FOSTER. Address the former, Harrisonville, Mo. In a former patent granted to Messrs. Sharp and Foster, No. 1,080,334, the disposition of the springs is such as to take care of compression, and an important object of the present invention is to provide an arrangement of springs positively fastened at the ends to the drive and driven elements thereby causing the springs to function for both compression and extension. The invention provides a more direct application of the springs to the drum.

LOOKOUT MAST FOR SHIPS.—A. BONOM, Central Bldg., Paterson, N. J. This improvement provides a mast which will not participate in the rolling and pitching of the ship so that the observer will not be hampered in his observation. The mast may rise considerably above the bridge and may be lowered to the bridge when necessary.

JOB PRESS STANDARDIZER.—W. S. MCMATH, 518 W. San Antonio St., El Paso, Tex. In this instance the invention provides a standardizer for job presses which may be secured to the bed of a press, thereby permitting the use of the press of a chase from a similar size press. It is never necessary to change a form from a small chase to another chase for use on the larger press.

SHEAVE BLOCK.—D. G. MANGES, Tellico Plains, Tenn. The invention provides a mounting for a sheave or pulley whereby the same is securely maintained in proper position in its housing and the latter, in turn, also held in position, and to this end, the housing is provided with suitable recesses through which extends an adjustable shaft supporting the housing in position and surrounded, in spaced relation, by a sleeve, the ends of which are supported in said recesses by bearings while the central position has mounted thereon the sheave proper.

SHOVELING MACHINE.—F. M. HEWITT, 213 N. Washington St., Butte, Mont. This invention provides an excavator of the chain and bucket type so called, which will be particularly adapted for use in mining and the like work in operating in tunnels and drifts to secure the "muck pile" or accumulation of dirt, rock, ore and other loose materials dislodged by blasting charges.

NAPKIN FOLDING MACHINE.—W. HEYER, address George W. Elkins, 34 Pine St., New York, N. Y. The inventor provides a folding device which embodies a table having a slot or mouth on which the article to be folded is placed, there being under the table a pair of folding rolls, and above the table a doubling bar having fingers which double and feed the article through the opening in the table to the folding rolls, which complete the folding operation.

GATE VALVE.—F. MILLIKEN, care of McNab & Harlan Mfg. Co., 55 John St., New York, N. Y. The invention relates to gate valves provided with a pair of seats and a pair of disks, and the object is to form these members so as to make a tight valve by bringing the faces of the disks and disk seats into perfect position and alinement, the arrangement being such as to also close the valves by bringing the faces of the disks against the disk seats with a uniform and great pressure.

PHOTOPRINTING MACHINE.—G. GROSTON, Hoquiam, Wash. This improvement provides a device of a self-contained nature having facilities for receiving and holding the sensitized paper or its equivalent, with means for acting upon the same with a white light for a predetermined time, the extent of which is automatically terminated and the light extinguished.

LATHE ATTACHMENT.—C. A. KULENKAMPFF, 123 White St., New York, N. Y. This improvement provides a construction which may be quickly applied and removed, the construction being such that when in use its acts as a milling or finishing machine. It provides an attachment for lathes which may allow the use of a milling tool, the structure being such that the article being operated upon may be directed back and forth, and may be gradually elevated at any time regardless of the shape of the article.

MACHINE FOR MAKING ARTICLES FROM PULP.—F. PRUYN and W. J. DE REAMER. Address Alexander Moir, 161 Chambers St., New York, N. Y. This invention provides a machine for making egg-case fillers and other articles from pulp, and arranged to allow of running the machine at a comparatively high speed with a view to economically turn out a large number of articles in a given time and requiring little attention on the part of the attendant.

DISPLAY RACK.—B. C. SCHAFFER, R. 3, Pratt, Kans. The invention relates to display racks in which the articles displayed are movable so that the same can be brought to a predetermined point. It provides an inexpensive rack from which any amount of the fabric positioned in the rack can be easily and quickly dispensed.

CLEANER FOR TUMBLERS FOR METAL CASTINGS, BUTTONS, AND OTHER ARTICLES.—M. A. DUNN, 383 Church St., Poughkeepsie, N. Y. The improvement prevents accumulation of deposit of scale, grit, or other debris, in the separating chambers provided in tumblers of conventional form; separates dust or light pulverulent matter from the deposit mentioned; avoids the necessity inherent in tumblers of conventional construction for discontinuing the service thereof during periods when the debris has accumulated in the separation chamber; and maintains at all times a free circulation of air through the tumbler.

AUTOMATIC PRESSER FOOT FOR SEWING MACHINES.—J. DUNNER, 547 Howard Ave., Brooklyn, N. Y. In this instance the invention has reference to sewing machines and particularly to presser feet used in machines adapted to sew sweat bands in hats, and has for an object the provision of an improved construction which will allow the hat to be quickly applied and removed.

BOTTLE FILLING MACHINE.—C. A. YOUNGMAN, 1217 2d St., Louisville, Ky. This invention pertains to the bottling of liquids, and provides a machine for such purpose which will control the quantity of liquid admitted to each bottle or other receptacle. It provides means whereby this result will be accomplished by gravity of the liquid to be bottled.

VALVE.—E. B. LORENZEN and H. M. ARTZ. Address H. T. Manner, 17½ N. Park St., Mansfield, Ohio. In this instance the invention is an improvement in a class of valves in which packing is dispensed with. The valve proper is a disk, which is held in a metallic cap or casing. The invention is more particularly an improvement upon the valve for which Messrs. Lorenzen and Artz have received Letters Patent No. 1,066,240.

WELL DRILLING MACHINERY.—W. A. MCCAUSLAND, 6735 McPherson St., Pittsburgh, Pa. The device has a slidable walking beam mounted substantially at its central point when the beam is being used in the drilling operation and capable of sliding with respect to the samson post so as to permit drawing of casings of greater length than could otherwise be drawn were not the beams adjustable. By its use the ordinary derrick is dispensed with.

POWER WASHING MACHINE.—W. H. FRANKLIN, Box 608, Red Lodge, Mont. The invention provides a small machine which may be set in a convenient and handy position, for instance, in a kitchen sink, for light washing and at the same time be self-operating in order to do away with the constant attention and manual work necessary at present in machines of this character.

WELL DRILLING APPARATUS.—W. A. MCCAUSLAND, 6735 McPherson St., Pittsburgh, Pa. An object of this invention is the provision of a tool for drilling wells, which may be assembled while the boring-bit is in the ground, thereby adding as much weight to the tool as is necessary to accomplish the boring in an efficient manner.

PNEUMATIC CUSHION.—I. A. LAKE, 3342 Hull Ave., Bronx, N. Y. This improvement provides a construction whereby air is confined in order to produce a cushioning effect. It provides a cushion device in which a pump structure is provided for maintaining the supply of oil in the air chamber of the device.

AUTOMOBILE SIGNAL.—M. H. NEWMAN, 1703 Atlantic Ave., Atlantic City, N. J. The invention refers to signal attachments for automobiles and similar vehicles and more particularly to visual signals designed to be attached to the windshield thereof, the main object of the device being to acquaint and notify others in the rear of the automobile carrying the signal of the intention of the operator thereof.

(*Continued on page 248*)

RECENTLY PATENTED INVENTIONS

(*Continued on page 240*)

CENTRIFUGAL SEPARATOR.—M. R. SPELMAN, Hyde Park on Hudson, N. Y. The general objects here are to inprove the construction and operation of centrifugal separators so as to be capable of a large output by being continuously in operation and entirely automatic as to the supply of the fluid to be separated and the removal of the solid particles from the basket.

SILK FINISHING MACHINE.—G. P. YUONO, 1120 Intervale Ave., Bronx, N. Y. The invention provides a constitution whereby the paste may be applied to the silk perfectly even and in any thickness desired. It provides an adjusting mechanism for adjusting the controlling roller of the device and the association therewith of locking means for locking the controlling roller after adjustment. Means provide for feeding the silk perfectly clean to the paste roller.

TYPEWRITER RIBBON.—J. T. AMISS, Baton Rouge, La. The object here is to provide a typewriter ribbon which may be replaced by a similar typewriter ribbon without winding one of the ribbons on a new ribbon spool, the ribbon having means for operating the reversing lever, and without the necessity of replacing the ribbon in the ribbon guide.

INKING MECHANISM FOR PRINTING MACHINERY.—T. F. ELSWORTH, 9 Temple Crescent, Beeston Hill, Leeds, England. The invention consists in means by which the duration of the dwell of the vibrating roller upon the ink fountain roller can be varied, while the machine including the ink fountain roller, is in motion. It further consists in obtaining a variable duration of dwell of the vibrating roller upon the ink fountain roller.

TOOL POST FOR PEARL BUTTON MACHINES.—P. F. DUSHA and A. FETK, care of Holub-Dusha Company, 1797 1st Ave., New York, N. Y. The invention deals particularly with a tool post adapted for machines of that type by which the sockets or recesses are cut on the face of the buttons. It provides a tool post of such construction that a better cutting action on the buttons can be obtained so that a sharp edge can be produced between the wall of the socket and the face of the button.

TRAVERSE MACHINE.—J. F. BENSON, 314 Middle St., Portsmouth, Va. This invention relates to a machine particularly adapted for mechanically performing certain computations necessary in the calculation of the area of land from field notes of the survey. It provides a machine with which the latitude and departure of any course may be obtained at one setting.

FLUSHING VALVE.—W. S. WHITE, 5101 Meade St., Denver, Col. The improvement provides a flushing valve operating in a reservoir in connection with which, provision is made for maintaining an air cushion, whereby to prevent water hammer or jar in the operation of the valve; provides in connection with the flushing valve, means for varying the period of flushing as desired; and provides a construction that will insure a proper flushing action and the refill of the bowl or other fixture after flushing.

PAPER BOX TAPING MACHINE.—M. B. DISKIN, 149 Wooster St., New York, N. Y. Mr. Diskin's invention relates to a machine for taping pasteboards and more particularly paper boxes. It provides a simple, strong and inexpensive machine whereby pasteboards or boxes of different sizes may be easily and efficiently taped on the same machine. It also provides means whereby more than one tape can be threaded simultaneously through the box.

GASKET MAKING MACHINE.—I. A. POWELL, 7014 Plateau Ave., St. Louis, Mo. One of the principal objects of the invention is to provide a machine for making gaskets or washers, incorporating means for shaping the gaskets, stamping or compressing the same, and then removing them from the die. The invention provides a device which is extremely efficient in operation, and inexpensive to manufacture.

MEASURING APPARATUS.—W. HANEL, care of Mrs. Zacker, 620 Newark Ave., Jersey City, N. J. This improvement refers to dispensing beverages and provides an apparatus more especially designed for use in refreshment establishments and arranged to enable the barkeeper to draw liquid to be dispensed either by the glass or by the pint, quart or similar unit measure.

GREASE GUN.—H. M. BOE, 2642 Fremont Ave., N., Minneapolis, Minn. This invention refers to containers for grease in paste or semi-liquid form, although it may be used for liquids, and provides such devices from which the grease may be applied to a point of use through a flexible hose by means of air under pressure, wherein the exact amount of grease dispersed may be accurately measured, and which may be quickly and easily recharged.

CONCRETE BUCKET.—C. A. NELSON, Box 261, Cristobal, Canal Zone, Panama. The invention pertains to buckets having dumping bottoms and means to release the bottoms for depositing the concrete when a bucket reaches the lowered position. Usually two cables are employed for hoisting and lowering a bucket of the class referred to and controlling the dumping bottom.

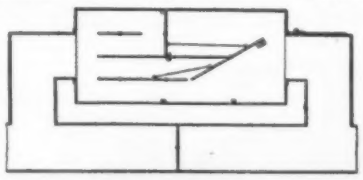
SHINGLE MACHINE.—T. W. ROACH, Tolt, Wash. One of the main objects of the invention is to provide a rotary carrier provided with a plurality of pockets adapted, each to receive a block which is presented successively to each of a plurality of band-saws to cut slabs of desired thickness therefrom.

COMPUTER.—G. M. MILNER, care of Milner Perrine Lumber Co., Buhl, Idaho. This invention relates to computers designed to indicate at a glance the price of the commodity dispensed by weight. It provides a simple, convenient and inexpensive computer which will afford a quick and sure determination of the price or prices of commodities dispensed by weight at rates that may vary.

OPERATING MECHANISM FOR PUMPS.—W. A. HARRIS, 238 John St., Greenville, S. C. The invention has reference to improvements in operating mechanism for pumps. An object of the invention is the provision of a novel form of pump in which a steady movement is secured by a novel arrangement of gears and springs.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE GOVERNOR.—G. W. TOPPING, 675 Seneca St., Brooklyn, N. Y. This invention provides a mechanism controlling the supply of fuel to an engine of this character; provides an automatic mechanism for the purpose mentioned; provides



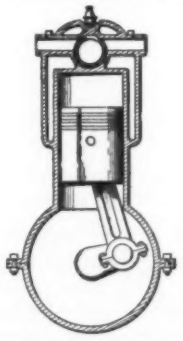
INTERNAL COMBUSTION ENGINE GOVERNOR

means for adjusting the automatic mechanism so that the same will operate in correspondence with the engine to which it is applied; and provides means for manually controlling the employment of the said governor.

INTERNAL COMBUSTION ENGINE.—J. O. STEPHENS, Big Island, Va. An object in this case consists in the provision of a multiple cylinder V-type engine in which is embodied a valve of a design whereby it is adapted to accommodate the functions of the twin cylinders between which it is located. Another object consists in the provision of means insuring the seating of the valve to prevent the escape of the gases from the parts.

POWER TRANSMISSION DEVICE.—G. C. BROWN, 1877 E. 87th St., Cleveland, Ohio. Among the objects of the invention is to provide means whereby power may be transmitted from a prime mover to a driven shaft with devices for rotating the driven shaft in either direction at any desired speed and while in any desired angular position with respect to the prime mover.

INTERNAL COMBUSTION ENGINE.—W. BOX, Georgetown, Tex. In this case the invention has for its object the provision of an engine having a rotary valve adapted to be continuously driven in one direction and so arranged that a



INTERNAL COMBUSTION ENGINE

charge will be drawn in, ignited, and exhausted in regular sequence, thereby driving the engine continuously. The engraving shows a vertical section through the cylinder of an engine provided with the improved valve.

INTERNAL COMBUSTION ENGINE.—A. J. ANDERSON, Address Christian Borup, Lakeview, Ore. The internal combustion engine has a novel form of intake and exhaust valve which consists essentially of a pair of oppositely rotated plates separated by a partition and body of the engine cylinder to admit and allow the gases to escape as the piston moves on its strokes.

POPPET VALVE.—C. D. COMPTON, 404 Bleecker St., New York, N. Y. Particularly, the invention relates to a valve of the indicated class having means whereby a turning movement will be imparted to the valve relatively to its seat in the normal operation of the valve, in order to effect a self-grinding action, by a varying presentation of the value to its seat.

SPARK PLUG.—E. BRANDQUIST, 48 Berwick St., Orange, N. J. The invention provides an arrangement whereby upon an inspection of the plug a person may see whether or not the same is properly sparking. It provides a plug in which

(*Concluded on page 252*)

Picking the One in a Thousand

You say to Westinghouse "I want a motor for my appliance" or "mill" or "machine."

Westinghouse says to you "You want *the* motor for your appliance" or "mill" or "machine."

What a difference that may make in dollars saved and troubles avoided!

Of the thousands of different kinds of Westinghouse motors there probably are a number that will serve your purpose. There is but one that will do it best.

To Westinghouse, selecting that one is as important as building the highest-grade motor.

Whether you want a motor for a steel mill or a washing-machine, a railroad locomotive or a coffee-grinder, Westinghouse will study your own requirements to determine the right type, size and characteristics.

Often this means weeks of careful investigation on the ground by trained engineers, followed by thorough testing at the Westinghouse plant.

In these investigations and tests, Westinghouse engineers have the great advantage of Westinghouse experience in the application of practically every kind of motor, from 1/100 to 15,000 horsepower. As a result they can not only recommend just the right one for you but may also be able to suggest mechanical changes that will simplify your problem and save you thousands of dollars.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

Westinghouse

MOTORS AND CONTROLLERS

The Destroyer and the Torpedo

(Concluded from page 219)

culates the course of his torpedo accordingly, the torpedo will reach the proposed meeting point too soon and will pass ahead of the ship. Vice versa, if he estimates she is traveling 25 knots when she is really going 30, his torpedo will arrive too late and will pass astern of the ship.

How difficult these calculations are is proved even in the attack by submarines at close range on slow-speed merchantmen; for many times during the past two years it has been recorded by the officers and crew of such ships that torpedoes have passed ahead or astern of them.

In spite of its visibility, the 30- to 35-knot destroyer, carrying from eight to twelve torpedo tubes, is the most effective means for torpedo attack. The work is hazardous, of course, but several flotillas of these craft, rushing down upon the enemy at 35 knots, particularly if they are protected by a smoke screen, are very likely to get a battleship or two, even though several of them are disabled or sunk by gunfire.

The smoke-screen or smoke attack, which has been used so frequently and effectively in this war, originated in the United States Navy, being first used in our destroyer fleet, when it was under the command of Capt. Eberle. The writer well remembers being present at such an attack off Block Island several years ago, when five groups of destroyers, 20 in all, crossed the head of a column of battleships, until they were in the windward position, and then, with the leading destroyers smoking heavily, swept down the line of the enemy at a distance of about 1,300 yards. The pall of dense smoke rolled down to leeward, enveloping the enemy and screening the destroyers from observation; but above the dense and low-lying bank of smoke could be seen the successive pairs of fighting tops of the battleships; and, had the maneuver been an actual battle, some of the capital ships would have been heavily torpedoed.

In the battle of Jutland, the German destroyers made use of this smoke-screen as a protection to their own battleships, when they were being heavily hit by the battleship divisions under Admiral Jellico. A noticeable feature of that fight was the use of fast 30- to 35-knot light cruisers, armed with 6-inch guns, as leaders of the destroyer flotillas. One well-placed shot from a 6-inch gun will usually cripple a destroyer, if indeed it does not sink her, and the object of these light cruisers is to lead the attack, break up the counter-attack of the enemy, and bring her own destroyers within torpedo range.

Origin and Culture of the Navel Orange

NEW light has been thrown upon the origin of the navel orange by study of the conditions surrounding its culture at Bahia, Brazil. Interesting facts were gathered by specialists of the United States Department of Agriculture who were in search of new plants in the South American country. All the evidence points to the fact that the variety of navel orange now so largely grown in the United States first came into existence at Cabulla, a suburb of Bahia, early in the nineteenth century, as a sport from the Selecta orange. The latter variety is still grown extensively near Bahia and in other parts of Brazil, and some of the trees show a marked tendency at times to produce fruit with well-developed navels. Such fruit, however, is not seedless, though the number of seeds is relatively small. The navel variety has almost entirely supplanted the parent variety about Bahia, where it has been known for more than 100 years. In the vicinity of Rio de Janeiro but few trees of the seedless variety are grown.

It was from a plantation near Bahia, so far as can be determined, that the budded trees were obtained through which the navel orange wood was introduced into the United States. Several were shipped to the United States Department of Agriculture. Trees were grown in the department greenhouses, and others propagated from them were distributed to

California and Florida. The variety proved to be unsuited to Florida conditions, but in California it is very productive and highly valued. Almost the entire present planting of the variety in that State can be traced directly back to two of the trees sent there by the Department of Agriculture in 1873.

The navel orange in Brazil, unlike its descendent in California, grows under warm, moist conditions. Seedlings of the bitter or sour orange (*Citrus aurantium*) are employed almost esclusively as stocks, and the navel orange wood is propagated on them by shield budding in essentially the same way that buds are propagated in the United States.

The navel orange as it occurs near Bahia is large, varying from 3½ to 4 inches in diameter, is yellow green in color, and extremely juicy and sweet. Comparative studies made by the Department of Agriculture show that the Brazilian fruits have a considerably lower precentage of peel than the California fruits and somewhat less fibrous matter or "rag." The California orange, however, has a much larger percentage of both citric acid and sugar.

Bud wood from a number of the most promising strains of the Bahia navel orange trees was brought to the United States by the department's plant explorers and is being tested in California and Florida. It is pointed out by the department that because of the important effect of climate on the size and character of the fruit it is impossible to determine in advance whether strains which appear desirable in Bahia will retain their characteristics in the United States. This can be decided only by the tests now under way.

The German Merchant Fleet

(*Concluded from page 238*)

But perhaps we can exhibit the distribution of these marooned waifs of the sea as well by means of a table as in any other way. The ports which harbor more than 10,000 tons of German steamships are the following:

Port	Vessels	Tons
New York	24	136,597
Rio Janeiro	13	48,562
Pernambuco	11	46,742
Sabang (Sumatra)	12	44,338
Boston	6	41,769
Manila	12	37,633
Valparaiso	11	35,623
Las Palmas (Canaries)	12	31,066
Montevideo	8	27,250
Telok Betong (Sumatra)	7	23,153
Baltimore	3	19,816
Callao	5	17,980
Philadelphia	4	17,892
Teneriffe (Canaries)	6	17,136
Antofagasta (Chile)	4	16,947
Punta Arenas (Chile)	5	16,454
Vigo (Spain)	5	15,874
Corral (Chile)	4	14,869
Trondhjem	2	14,641
Honolulu	7	13,881
Padang (Sumatra)	3	12,157
Tjilatjap (Java)	3	11,589
Santos (Brazil)	3	11,397
Bahia	4	10,638
Pisagua (Chile)	3	10,390
Buenos Ayres	3	10,266
Colon	4	10,165
Bahia Blanca (Argentine)	3	10,049

In addition to these, we find one or more German merchantmen "in port" in the harbors of New Orleans, Pensacola, Charleston, Newport News, Jacksonville, Savannah, New London, Clifton, O., Southport, N. C., Zamboanga and Cebu, P. I., Hilo, Tutuila (Samoa), San Juan, St. Thomas (in our newly acquired Danish West Indies); Paranagua, Maranhao, Cabedello, Santa Catharina, Parahiba, Rio Grande and Para, Brazil; Caldera, Talcahuano, Iquique and Coronel, Chile; Rosario and Port Madryn, Argentine; Caleta Buena and Mollendo, Peru; Havana and Cienfuegos; Tampico and Santa Rosalia, Mexico; Cartagena and Sabadilla, Colombian Republic; Curacao, Shanghai, Bangkok; Bilbao, Cadiz, Palma, Almeria, Huelva, Seville, Barcelona, Corunna and Villagarcia, Spain; Surabaya, Amboina and Banjoewangie, Java; and Macassar, Celebes. Truly it seems an insignificant port that does not harbor at least one of these German lame ducks.

The Machinery of Ships

(*Concluded from page 221*)

facturers and their actual construction in the near future may be looked for.

The Semi-Diesel engine in which is included the various hot bulb engines are especially adapted for small powers below 500 H. P. These engines are simpler than the Diesel, have no air compressors and do not use high compression. They are nearly as economical as the Diesel engine. They are being particularly employed in small light powered freighters and in auxiliary sailing vessels. The auxiliary sailing vessel of wood or iron of 1,000 to 3,000 tons displacement is entering the field of the freighter and by its low cost of operation will beat the small tramp steamer as a competitor.

The auxiliary freighter with its oil engine can make six to nine knots with its machinery alone and with a favorable wind may make 14 knots. The personnel required is no more than that of a sailing vessel of the same size.

The present developments are matters in which skill in design and manufacture and the application of high grade materials to specially suitable purposes is needed and wherein highest grade workmanship is essential. When designs and details are fully developed they can be standardized and then the manufacture put on an economical basis.

The Unarmored Battleship

(*Concluded from page 218*)

The warship of highest speed with guns outranging any vessel afloat need carry no side armor for protection against the gun. Even the number of guns carried is unimportant except to shorten the time required to destroy an enemy. Once a vessel embodying this idea is built, a similar but faster and stronger vessel in a rival's fleet will appear. Thus, we shall see the old course of evolution repeated in a new cycle.

The Battle of the Caribbean

(*Concluded from page 227*)

whole section of her side armor was driven bodily into the ship. She dropped out of line mortally hurt, and, heeling rapidly, capsized and sank, fifteen minutes after the action opened.

Our leading ships then concentrated on the "Helgoland" and "Ostfriesland," first and second in line; and, in order to cover them, the battle-cruisers, risking the penetration of their belts by our 14's, drew ahead clear of the dreadnought line and closing in to 15,000 yards began to plant their salvos on the Oklahoma and Nevada.

Their shells, falling at a steep angle, were dropping on our decks; and it was one of these that pierced the protective deck of the Nevada, smashed a low-pressure turbine, and threw this fine ship out of the line. She stopped and drifted astern. When I last saw her, she was blazing away with her 5-inch batteries at a swarm of German destroyers, which had rushed in, like a crowd of angry terriers, to get her with the torpedo.

The fight had now been on for half an hour and we were asserting our superiority. The battle-cruiser "Von der Tann" had been badly hit and was settling by the stern. The fire from the German dreadnoughts had perceptibly slackened, and the "Thuringen," at the tail of the column, was again in trouble with her steering-gear and had fallen behind. Although our ships had been badly knocked about in their upper works and some of the turrets had been disabled, the water-line was intact on every ship. Victory was in sight, and we on the fire-control platform were jubilantly slapping each other on the back, when, happening to look landwards (we were now clearing Cape Maysi, the extreme easterly point of Cuba), I saw the leading ships of a column of warships moving past the point and bearing down diagonally upon our port bow.

I touched the spotter on the shoulder: "Carlisle, look at that; what is it?"

He swung his glasses upon the fleet (it was clear of the point by now) "That, my

dear sir, is the other and stronger half of the German fleet, four Koenigs and the five Kaisers."

"Good Heavens. Then we are in for it."

"In for a licking, my dear boy, if they can do as good shooting as our friends over there," with a wave of the hand to the starboard.

"But the radio from Key West told us that this fleet was a thousand miles north from here."

Carlisle was silent for a moment. "Did you not think it strange that we should have been able to communicate only with Key West radio station—not a word from Colon or Arlington?"

"Yes, I had thought of that."

"Well, that second fleet coming out from under the lee of Cuba has made everything as clear as day to me. The Germans have raided our coasts (why—we may never live to know), seized Key West, and using our secret Code (which their confounded Intelligence Service has undoubtedly gotten hold of), have led us, in their own good time, and with true German precision, into this trap. Just look at that! They are going to tee us."

And there we saw the four battle-cruisers, going 28 knots, forge ahead of the German column, and draw in, diagonally, across our path.

By the time the second fleet of the enemy had closed in to 12,000 yards and opened fire, the cruiser division was zigzagging across our course, 10,000 yards ahead, and delivering a raking fire right down our line, first letting fly to starboard, then to port.

A hurricane of fire and steel smote the head of the American line. By preconcerted plan, every ship of the enemy, from starboard, from port, and from dead ahead, concentrated on the Oklahoma. Never had such a fury of shell stormed upon ship or fortress as found and searched out the American flagship. In those brief minutes before she sank, all semblance of a ship had gone out of her. The roar of bursting shells was continuous. From side to side and from end to end they tore through her quivering frame and laughed at her dying agony.

And I am told that what happened to her happened at the head of the surviving line, until the last ship had gone—the column melting away before that concentrated fire like a bar of sealing wax before a blow-pipe.

I remember, as the noble ship keeled swiftly over, how the fire-control platform described a mighty arc through the air, and flung us into the shell-lashed waters. My last recollection of that holocaust is of seeing the Arkansas, flashing from stem to stern with the burst of high-explosive shell as she swept by. Then a shell fragment grazed my head.

* * * * * * * * *

The water, or I know not what, brought me to. Far in the distance the flash and smoke and roar of battle marked where the last American ship was being done to death, the dear old flag flaunting its "no surrender" message to the bitter end. And then, as the said vision and all vision began to fade away, I heard sharp words of command, and the swish of backing propellers, and something jerked me violently by the collar, and I was lying upon my back, and a familiar voice was saying: "Bless my soul, if it isn't Watson! What in the name of the unexpected and impossible are you doing here?"

And I had been fished out of the water by a boat hook and landed on the deck of the U. S. Destroyer "Patterson"; and there was Commander Judson, whose guest I had been on this very boat, during a never-to-be-forgotten week of the summer maneuvers last year.

"I came down to witness director firing on the "Oklahoma" and—well—I saw it—And you, what are you going to do?"

"Beat it for Hampton Roads, or any other point where I can get in, to tell the good people of the United States to what a pretty mess they have brought their Navy, as the result of many long years of indifference and neglect."

America and Germany—A Comparison of Naval Strength

(*Concluded from page 233*)

many has in commission to-day 20 and the United States 12; that of battle-cruisers Germany has five in commission and the United States none (six have been authorized and the construction of four will be commenced very shortly) of predreadnoughts Germany has 19 and the United States 22.

The statement of mere numbers is, of course, only a rough-and-ready method of getting at the strength of the two navies; for, to judge of the real value of these numbers, we would have to know something about the size, speed, armament, defensive qualities, fuel capacity and ammunition supply of the individual ships; also, the emplacement, arcs of fire, ability to train on either beam, and the weight and penetrative power of the individual guns. Now, to make an exhaustive study of the subject along these lines would take a whole issue of the SCIENTIFIC AMERICAN; but by way of suggesting what modification of the mere totals given in our drawing would have to be made, we draw attention to the fact that although the German Navy includes 25 completed dreadnoughts and battle-cruisers, as against 12 completed in the United States fleet, the average displacement of our dreadnoughts is 25 per cent greater. That is to say, the average displacement of a United States dreadnought is 25,625 tons, as against 20,550 tons for the German dreadnoughts. Now, unless some grave errors have been made in her design, a ship which is of 25 per cent greater displacement should present a 25 per cent greater all-round efficiency than the smaller ship. For this reason we believe that ship for ship and date for date, our dreadnoughts are more than a match for those of the German Navy. With equally good handling and equal gunnery, our ships should be more than a match for an equal number of German ships.

On the other hand, Germany has five battle-cruisers of 28 to 30 knots speed, and if we went to war they would present a distracting problem for the Commander-in-Chief of our 21-knot dreadnought fleet. He would not have sufficient speed to bring them to action; they could sink our slow and lightly-armed scouts, should we send them out to find the enemy; they could obtain information of our movements with little risk to themselves; and, if they elected to sink our merchant ships and raid our coasts, they could do so with comparative impunity.

To be sure, we know very well that all these dire possibilities could happen only if the German fleet came out from its hiding places and swept the fleet of Great Britain out of existence. Great Britain, of course, is fighting for herself; but that does not alter the fact that the 50 dreadnoughts of Admiral Jellico's first line of battle are also our first line of defense against that country with whom we have recently broken off diplomatic relations. The above considerations show how necessary it is for the United States to rush to completion the division of six great 35-knot battle-cruisers, which constitute the most important elements of our new naval program. With some modifications of their motive power, necessary to bring the boilers below the water-line and the protective deck, and with legislation enabling us to work three shifts of men upon these ships, it would be possible to have them completed and in commission within two years from the present date.

The most important element of a navy is its dreadnoughts. They form the first battle-line, and no judicious Commander-in-Chief would think of pitting his pre-dreadnoughts against the enemy's dreadnoughts.

Now the present war has shown that it is the gun and not the torpedo that wins battles, and, estimating the two navies on a basis of gun-power, we find that Germany possesses 26 dreadnoughts mounting 252 heavy guns, whose total energy is 12,721,920 foot-tons, and that against this fleet we could oppose 12 dreadnoughts (now in commission) mounting 128 guns, whose total energy is 7,417,736 foot-tons.

The comparison of predreadnoughts is more in our favor; but lest we deceive ourselves, we must remember that dreadnoughts and not predreadnoughts, will decide the naval campaigns of the future. Germany has 19 predreadnoughts mounting 76 armor-piercing guns; (though it is doubtful if the 9.4-inch gun of the "Kaiser Friederich III" and the "Wittlesbach" classes, should be called armor-piercers) of a total energy 1,500,000 foot-tons. Against these we could oppose 22 ships mounting 96 guns of a total energy of 3,876,545 foot-tons. Among the dreadnoughts we have included the "Michigan" and "South Carolina," whose comparatively low speed shuts them out of the dreadnought class.

Our great superiority in gun-fire is due to the fact that we started out right by mounting 12- and 13-inch guns in our early battleships, whereas the Germans fell into the error of mounting 9.4-inch guns, in the belief that volume of fire is of more value than weight of fire.

A Grave Military Defect in Our Battle-Cruisers

(*Continued from page 232*)

mechanical gear, which was the first of its kind and therefore somewhat experimental, an improved gear has been installed, and is now operating with great success, and with the very low loss of efficiency in the gear of 2 per cent. The loss in the electric drive is from 7 to 8 per cent. The mechanical reduction gear, as compared with the electric, has the advantage of compactness and much smaller weight and cost, the saving in each battle-cruiser being 1,000 tons of weight and $1,300,000 in cost. The electric drive has the advantage of being able to reverse with full power, as against 60 per cent of full power for the gear drive. In this connection it should be stated that no prudent captain of one of these battle-cruisers would think of reversing with the full 180,000 horse-power available, because of the enormous vibration that would be set up in the structure of the ship. The 100,000 horse-power available for backing with the gear drive would be amply sufficient even for an emergency stop.

Referring to our little diagram of the two drives, it will be seen that mechanical geared drive interposes between turbine and propeller merely a pinion and spur-wheel, whereas the electric drive interposes all the massive machinery necessary for a double conversion of power, namely, the generators for developing electrical energy and the driving motors for converting the electrical energy to mechanical power on the propeller shaft. When the Bureau of Engineering came to work out the plans in detail, they found the electrical plant encroached on the space usually given up to the boilers to such an extent that one-half of the boilers had to go above the protective deck. When they tried to develop a plan with all the boilers below the protective deck, they found that they would have to encroach upon the spaces provided as a protection against torpedo attack, and rather than do this they preferred to leave the underwater protection intact and take chances of half the boiler plant being destroyed by gun-fire.

One of the private shipyards, convinced that the Government would never sanction the construction of these ships with the boilers in such an exposed position, and knowing that the reduction geared drive would make far less demands on space, made a study of the proposition of getting all the motive power below the protective deck without vitiating any of the underwater protection provided by the naval constructors; and they found that it was possible to do this, not omitting the auxiliaries in the way of blowers, pumps, electric lighting plant, etc. Moreover, it was found possible to install a cruising turbine which would give the same economy at low speed as was shown by the electric drive, the economy at full power being the same in both systems.

Finally, the placing of all boilers below decks, rendered it possible to substitute three smokestacks for the seven smoke-

stacks necessary when the boilers are carried on two decks.

Now from the military standpoint this reduction in the number of smokestacks is of great importance; for a quartering view of these ships, such as would be obtained by the enemy when he was off the bow or the quarter, would open up the cluster of smokestacks so that everyone would be visible, and they would form an all-but-solid target, 60 feet high by over 200 feet in length. In these days of extremely long-range fighting, when visibility is of supreme importance, this definite mark placed as it is above these unprotected boilers would be another military disadvantage, the full force of which would only be appreciated by the men who have to command these battle-cruisers in battle.

We close this article with three propositions, which we believe cannot be disputed:

First, that these valuable ships, the very cream of our new navy, must never be built with their boilers in this exposed position.

Second, that in order to bring the boilers below deck, the geared drive, which the Chief Engineer has recommended for our new 90,000 horse-power scouts should be installed.

Third, that if the Department find sufficient good reasons for using the electric drive, the ships should be lengthened sufficiently to permit all the boilers to go in below the protective deck.

Suture Manufacture in America

AT the outbreak of hostilities in Europe a very serious problem was presented in view of the fact that practically all of the raw catgut used in this country for surgical purposes was made in Germany. A Committee of the American Chemical Society on looking into the matter finds that existing conditions are not so serious as pictured, and in fact are, on the contrary, very promising.

These very essential requisites of the surgeon are not catgut at all, but result from the proper treatment and curing of sheep intestines. American manufacturers have for many years been very skilful in converting the cured gut into a high grade suture, but as in other lines they have taken the way of least resistance and have been content to import the raw materials. As the demand for this very important article increased, it became necessary to look about for a domestic supply. Naturally, the attention of the great packing houses was directed to this subject, and almost over night several plants were erected, equipped, and are now engaged in suture manufacture.

The methods employed in curing the gut have been held as more or less family secrets on the other side of the water, but when the Yankee got busy he soon unravelled the secrets and to-day is producing a cured gut which is far superior in strength and appearance to those which were formerly imported.

Our Aerial Coast Defenses

(Concluded from page 223)

anti-aircraft service with rapid rate of climb, but small radius of action and carrying capacity; bombing machines with exceptional load carrying powers and escorting aeroplanes effectively armed. In fact, the types of machines required are almost identical to those already employed for use on land.

Seaplanes are by no means the only aeronautic equipment, for dirigibles and kite balloons also come in for their share of service, both in the naval and coastal defense service. In the case of the former it is interesting to note that Great Britain has evolved a small type of dirigible, provided with an aeroplane body and known as the "Blimp" type, for patrol duty; and according to reports it is understood that hundreds of "Blimps" are proving highly satisfactory in patrolling the waters of the British Isles. A small dirigible of this type, making a speed of 0 to 60 miles per hour, has the advantage of not only remaining stationary, if need be, but of a radius of action of some five hundred miles. It has a unique place in coastal defence and patrol service, which

is not quite filled by any type of seaplane. With regard to the kite balloon, the same is again true; for where a fixed, elevated observation post is necessary, the kite balloon is unexcelled. Just as much at home on water as on land, the kite balloon is employed for naval operations in conjunction with a special mother ship, when possible.

Obviously, the equipment just outlined represents the last word in naval aeronautics, and as likely as not our Navy would not require so complete an assortment of aircraft. But the fact remains that a hostile power waging war along our coasts would, most probably, have a complete aerial service, and unless our's was equally efficient we would be that much at a disadvantage. But the matter of present equipment is not the most serious aspect of the situation, since, given the required appropriations, our well-developed aeronautical industry could soon turn out seaplanes of all types, kite balloons, propellers, engines, dirigibles, and other requisites, in time of war. Unfortunately, however, the same can not be said of the personnel.

Equipment is a matter of production, but personnel is a matter of training. The first can be speeded up in time of emergency, but the second requires the same length of time no matter what the circumstances may be. If this were not so, then there would be no necessity for training the personnel until we actually engaged in war. Our aircraft industry to-day is such that the manufacturers can turn out several hundred seaplanes a week, if need be; but it requires several months to train each aviator. With the necessary number of trained aviators ready for instant service, it would not be a difficult matter for the Navy and Army to secure the necessary equipment for Naval and coast defense purposes. So in the broadest sense of the word the immediate need of the country, in the Army and Navy alike, is for a large army of trained fliers, rather than ready equipment.

The training schools of the Navy now in operation, like those of the Army, one of which was described in a recent issue of SCIENTIFIC AMERICAN, are not equal to the task of training the aviators immediately required for emergency service. While the requirements of the Army call for 1,000 aviators as a minimum, in the case of the coastal defense it has been estimated by Rear Admiral R. E. Peary that we should have a minimum of not less than 2,000 seaplanes ready for duty on the Atlantic Coast, and an equal number on the Pacific, and that 5,000 on each coast would be better. Then, and then only, would ports and coast cities be reasonably safe from air attacks—even submarine attacks on our shipping would be rendered most difficult, since the seaplane is a most effective agent in the detection and destruction of submarines.

It is to be hoped that the Navy—our first line of defense—and the Army will eventually get together an aerial fleet which will be comparable to those of other powers. But under the present way of doing things it will require years of patient effort to realize an efficient aerial defense—and in the meantime we are not prepared for an emergency. This brings us to the most promising plan now before the authorities for providing adequate aerial defenses immediately.

Much merit indeed is attached to the proposal of the Aerial Coast Patrol, the guiding spirit of which is none other than Rear Admiral Peary. Briefly, the plan calls for a series of seaplane stations 100 miles or less apart, along our entire coast from Eastport to Brownsville, and from San Diego to Cape Flattery. In peace times the seaplanes will be engaged in training; in the practice of spotting submarines and mines, dropping bombs, recognizing ships; in studying every detail of their respective stations, and in scouting for ships in distress, derelicts, or any other accidents of the sea or shore. In time of war these seaplanes, equipped with the necessary apparatus, will form a continuous flying cordon around the country some hundreds of miles off shore, to detect and warn of the approach of any kind

of craft, with an inner line scouring the sea continuously for submarines and mines. In short, the patrol would be a national burglar alarm, as it were, around the country, making it difficult if not impossible for anything to approach without detection.

Yet the patrol, while complete in itself, is but the first step and part of a logical system of aero coast defense, other features of which will be a series of great squadron stations near all of our large cities, as a protection against air attack upon those cities, and as a powerful means of offense and defense against hostile fleets. The scout planes of the patrol having warned of the approach of a hostile fleet, the great battleplanes of the squadron stations could rise and give the invader battle. Naturally this latter phase of the aerial preparedness would be in the hands of the Army authorities, just as in the case of the aerial defenses of the coast fortifications. In fact, the Army must coöperate to a large extent with the Navy and with the Aerial Coast Patrol at all times. The coast fortifications must be provided with aerial squadrons, dirigibles, kite balloons, and anti-aircraft artillery, to such a degree as necessity dictates.

Rear Admiral Peary estimates that a thousand seaplanes along our Atlantic Coast would double the efficiency of our Naval defense and increase the value of our coast protection 200 to 300 per cent. And the present key to our preparedness in this direction is a numerous flying personnel—thousands and thousands of courageous young men, capable of handling aeroplanes as the expert chauffeur handles his car.

We should throw all available strength into aerial preparedness with unsparing energy, announces the North Pole's discoverer. The present policy is to give some strong, broad executive full and undivided control in this field. If this can be done here, and the training of 2,500 aviators within six months and 5,000 within a year made mandatory, it will be of the greatest value. This training is the all-important thing then, for again it is repeated that the equipment can be secured at short notice.

Where can the personnel for the Aerial Coast Patrol be obtained?

By way of answer it is pointed out that along our thousands of miles of coast there is a quantity and quality of personnel that is among the most valuable assets of this country. It is the personnel composed of the young boatmen, sailors and those who have been brought up beside and earned their living on and by the ocean. It is a personnel which, from the very nature of its existence, is hardy, is courageous, is enduring, knows the sea and its ways, has the sense of navigation born in it, and above and beyond all has the element of personal initiative and execution developed to the highest degree. For instance, the young fellow who, from the age of six or eight, has been handling his own boat, and perhaps from the age of twelve has, single-handed, driven his fishing boat almost out of sight of land off shore, has made his day's haul and driven his boat back home again in the tooth of all kinds of weather—that is the ideal personnel for the aviators of the Coast Patrol and for the Government. The utilization of that invaluable personnel should be complete, and it should be begun immediately.

"Steps should be taken at once to bring to the front and register all of this material along the entire extent of our coasts," states Rear Admiral Peary. "Personally, I believe it would require but a comparatively short time to so register not less than 5,000 young men. I may be wrong, but it can do no harm to make the effort. With these men registered, a preliminary physical examination should be made, which could probably be done by existing recruiting stations at various points along the coasts without expense. Assignment to the squadrons should then follow, and instructions begin just as fast as a squadron personnel was completed. If suitable machines are not available by that time, any old school or semi-obsolete machine can be utilized temporarily for primary

instruction, and even if anything of this kind is not available, then book and oral instruction can be utilized. As soon as machines are delivered they should be assigned to these squadrons in order of their formation, and the work of actual serious training begun and prosecuted without interruption.

"Personal work of arousing interest and recruiting these men is essential. It cannot be done at long range. If they could be spared, and could undertake it, it would be a great thing if these young men of Coast Patrol Squadron No. 1, Davidson, Lovett, Gates, could be sent out each one to a different section to kindle with the sacred fire of youth and devotion to the country which permeates them, a similar flame in each locality. The entire organization should be placed in charge of some active young executive who can run 1,500 revolutions per minute for twenty-four hours a day, until this personnel is assembled and under training.

"The Navy Department has aeronautical estimates for the present year in round numbers of $5,000,000. The perticular aeronautical province of the Navy is scouting for information from the ships, and spotting gun work, also, the use of dirigibles and the kite balloons for observation work.

"The War Department has aeronautical estimates in round numbers of $4,000,000 for aeronautical work in connection with our coast fortifications. The specific work of the Army in this direction is that of securing information of possible enemy movements in the vicinity of fortifications and in spotting gunwork.

"The Coast Guard under the Treasury Department has authorization for the establishment of aviation stations along the coast, but no money has been appropriated for this service.

"None of these Departments fills the place of the Aerial Coast Patrol. That is a broader proposition than the others and covers contingencies which they do not. There are numerous portions of our coast where there are no fortifications and which are not specifically covered by Navy work—places on which landings of hostile forces might be effected. And once a hostile force secures a foothold on our shores, then every city and community in the country may be the victim of his air forces.

"The Coast Patrol need not antagonize or duplicate any of these other departments. On the contrary, it will most effectually supplement and strengthen them. There is ample room for additional appropriations for the Aero Coast Patrol. Last year the total aeronautical appropriations for the Army and Navy were in round numbers $18,000,000. The estimates for both services this year are in round numbers somewhat over $20,000,000, a total of $40,000,000 for the United States in two years.

"What are other countries doing?

"Last year Great Britain expended $250,000,000 on her aeronautical department. Canada, our next-door neighbor, has decided to expend $80,000,000 this present year in putting a great air fleet in commission.

"Is there any reason why we need only one-fourth the aerial equipment and development of our neighbor?

"We shall not have started on a proper pace of aeronautic development until we are spending not less than $50,000,000 annually on the building of our air service.

"I can imagine any one of several foreign powers, in the light of their dearly bought experience of the past two years, voting without a moment's hesitation $20,000,000 or $30,000,000 on such a vital thing as the Coast Patrol, and then pushing it with feverish energy.

"If the Navy and War Departments are unable, or unwilling, to take up this vital proposition of an Aerial Coast Patrol, then let us take it up as a separate proposition. And if the Government is not ready to take it up directly, then some civilian interest should be authorized to organize it under the supervision of and with responsibility to the Council of National Defense."

RECENTLY PATENTED INVENTIONS

(Concluded from page 242)

a dead section is produced with one end extending exteriorly of the engine when the plug is in use, thus allowing the operator to see whether or not the plug is sparking without removing the plug.

GOVERNOR MECHANISM FOR COMPRESSOR ENGINES AND THE LIKE—M. E. TEAGUE, Bowson House, Cinderford, Gloucester, England. This invention relates to governing mechanism for compressor engines and the like of the type in which a combined centrifugal and pressure governor is employed. It provides an arrangement of the above type and the invention consists in governing mechanism comprising an expansion valve operated by a rack bar, a speed governor and a pressure governor each of which is adapted to act separately when required upon the rack bar.

SPARK PLUG.—A. H. WALLACE, 147 E. 81st St., New York, N. Y. The principal object here is the production of means whereby the spark gap may be adjusted without removing the plug. Another object is to provide means whereby the side plugs are rotated to any desired extent and means are provided exteriorly of the plug for indicating the amount of rotation and, consequently, the length of the spark gap produced.

SPARK PLUG.—R. HUGHES, 210 S. 3d Ave., Mount Vernon, N. Y. The invention provides means for protecting the porcelain from cracking; provides means whereby the plug may be cleaned without removing the same from the cylinder, as well as the contact points; provides means whereby new contact points may be utilized at will without removing the plug from the cylinder and provides means whereby the spark gap may be adjusted at will without removing the plug from the cylinder.

VALVE GRINDING TOOL.—B. B. BEAN, care of The Handy Garage, 53 Broadway, New Haven, Conn. The invention provides a tool more especially designed for grinding valves of internal combustion engines such, for instance, as are used in automobiles, motor boats and the like, and arranged to permit the user to readily grip and turn the valve in its seat and to allow of occasionally lifting the valve to facilitate accurate grinding of the valve in the seat.

INTERNAL COMBUSTION ENGINE.—H. OLDHAM, Box 201 Escondido, Cal. The invention relates to internal combustion engines of the so-called reciprocating-rotary type, that is, to engines in which motion is conferred upon a rotor or revoluble member by the action of cylinders containing pistons having a thrusting movement so directed that the pistons turn bodily with the rotor.

INTERNAL COMBUSTION ENGINE.—H. C. WELL, 1175 Wyatt St., Bronx, N. Y. The engine has a valve sleeve having a port for the admission of air under pressure and an exhaust port, these ports being uncovered at the same time to force through the cylinder cool air under pressure thoroughly to cleanse the cylinder of products of combustion. The sleeve has a port for the admission of compressed air at the end of the suction stroke of the engine to improve and to increase the pressure of the combustible mixture in the cylinder.

EXHAUST MUFFLER.—G. F. TURNER, 317 North Cedar St., Mahoningtown, Pa. The invention is more particularly intended for use as a muffler for the exhaust of an internal combustion engine. An object is to provide a device that will effectively muffle the sound of the exhaust without appreciably creating back pressure.

VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES.—H. C. WELL, 1175 Wyatt St., Bronx, N. Y. An object here is to space two of the cylinders apart and elongate the stud extending from one of the cylinders to the other and on which the gears are mounted which mesh with the gearing on the sleeves, this elongated stud being provided with a sprocket wheel with which is connected a sprocket wheel on the crank shaft by a sprocket chain for driving purposes

INTERNAL COMBUSTION ENGINE.—H. C. WELL, 1175 Wyatt St., Bronx, N. Y. The invention provides an engine having a piston with two scavenger ports, and provided with a valve for rotating on the piston for opening and closing the ports, a beveled gear being secured to the valve which meshes a bevel gear mounted coaxially with a piston rod and operated thereby.

Railways and Their Accessories

RAILWAY TRACK CLEANER.—F. L. WARNER, 139 Clinton St., Brooklyn, N. Y. The improvement provides a machine including one or more mouthpieces adapted to be moved along the surface to be cleaned, and each comprising means to create both a suction and air blast within or beneath such mouthpiece, together with auxiliary agitating means to facilitate the loosening up and delivery of the dirt.

RAILROAD TRAFFIC CONTROL EQUIPMENT.—B. F. WOODING, 162 Walnut St., Montclair, N. J. The invention provides a railway road-bed with traffic control appartus capable of avoiding tools, such as snow-plows, for cleaning the road-bed, and for avoiding other members carried by locomotives or trains purposely or accidentally pendent therefrom in the path of said control apparatus; provides characterization current—supplying vamps resiliently suspended in an operative position to be readily depressed therefrom when struck by a moving object; and provides a suspension mechanism for the vamps.

LOCOMOTIVE ASH-PAN.—W. W. SYKES, 916 Bainbridge St., South Richmond, Va. This invention provides against warping of the ash-pan under excessive heat, and provides for the proper operation of the dumping doors even though warped by the heat, and the invention includes improvements in the mechanism for dumping the doors, the nature of which renders extension from a single to a double ashpan or three or more opening pan peculiarly simple and convenient.

Pertaining to Recreation

FIGURE TOY.—H. A. HART, care of Baker & Bennett Co., 873 Broadway, New York, N. Y. The invention provides a toy in the form of two figures prefectly representing acrobatic clowns, which are adapted to be set up on a flat surface, like a table, singly or together, to represent certain acrobatic feats, the figures being each made of a flat piece with a contour or outline of such configuration that various surfaces are presented forming bases upon which the figure can be set up.

TARGET TOY.—H. A. HART, care of Baker & Bennett Co., 873 Broadway, New York, N. Y. The invention provides a novel target in which the object to be hit will, upon being struck by a projectile, flies into the air and entirely leave the supporting frame of the target to simulate a frog jumping out of the water, to the amusement of the child using the toy.

DISAPPEARING AND RECURRING REVOLVING TARGET TOY.—H. A. HART, care of Baker & Bennett Co., 873 Broadway, New York, N. Y. The principal object here is to provide a novel target including a plurality of target elements so mounted that one is exposed at a time and when the same is hit by a projectile fired thereat the hit target element disappears and another target element takes its place automatically.

ICE SKATE.—M. A. WACHS, 102 W. 142d St., New York, N. Y. The invention provides an attachment for any common or well known type of ice skate, said attachment being arranged adjacent the heel and so placed as to provide a broad standing base for the skate while at rest and as a means for protecting the ankle from pain or dislocation or unnecessary fatigue, but so designed as not to interfere with the usual skating function of the skate.

ARTICULATED DOLL.—E. P. NICHOLSON, 932 Birch St., Richmond Hill, L. I., N. Y. This invention has reference more particularly to the means for controlling the articulation of the doll. It provides a simpler and less expensive arrangement whereby the articulation of dolls may be controlled. It provides an articulated doll which can be easily and quickly assembled.

GAME BOARD AND GAME.—J. L. DEVLIN, 801 Lipon St., Denver, Colo. This invention is an improvement in game boards and games, and provides a board of the character specified upon which a variety of games or variations of the same game may be played by two or more players. The game may be played in several different ways, with railroad trains and base ball.

Pertaining to Vehicles

VEHICLE SPRING.—C. F. HOWELL, P. O. Box, 105 Watertown, N. Y. The invention is intended for embodiment in the elliptical springs employed on automobiles, and relates especially to the means for mounting the upper sections of the respective side springs on the vehicle frame and connecting them with each other, the purpose of the invention being to equalize the action of the springs at both sides so that a movement of one will result in a corresponding movement of the other.

VEHICLE TIRE.—C. F. A. GRAY, 46 Richmond Square, Montreal, Canada. The objects of this invention are to provide a tire casing or shoe of such thickness as to prevent puncture of the inner pneumatic tube without reducing the flexibility or resilience of the tire; to greatly minimize or totally prevent the occurrence of blow-outs; and to provide a tire which will be more durable than those at present in use.

VALVE FOR PNEUMATIC TIRES.—J. W. TAYLOR, 1445 Mt. Elliott, Detroit, Mich. This invention is more particularly an improvement in valves for pneumatic tires as shown in Mr. Taylor's Patent No. 1,108,640, the object of the invention being to rearrange the parts on such manner as to provide a compression joint in the path of air from the outer end of the valve tube and at the same time enable certain of the parts to be more economically constructed.

LIFTING JACK AND PULLING DEVICE.—G. A. PIPER, care of J. C. Isaacs, 1105 S. Paxton St., Sioux City, Iowa. This improvement has reference to lifting and pulling devices especially designed for use in connection with automobiles as a jack for lifting the axles, and as a puller for drawing the automobile out of ruts or other places when the car is stalled.

SIGNALING DEVICE FOR MOTOR VEHICLES.—M. J. DALTON, P. O. Box 187, Chula Vista, Cal. The invention provides a device for use with motor vehicles of any character, wherein a staff or lever is provided, having at one end a signal and at the other a grip, and mounted on the hood to swing from side to side, to indicate whether the vehicle will continue straight ahead or turn, and in what direction the turn will be made.

FENDER AND TAIL LIGHT SYSTEM.—H. A. LACERDA, 303 Campbell Ave., Schenectady, N. Y. In this patent the invention has reference to an indicating light system for automobiles in in which lights are arranged on the front fenders to indicate the position of the automobile either when moving or standing, to thereby enable other cars to safely pass.

Note.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the inventor, and date of this paper.

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The *slip*-shod driver is one who leaves tire chains in the locker when careful drivers put them on their wheels. Driving with chainless tires over wet-slippery-skiddy streets he gambles with the lives and property of everyone in his path.

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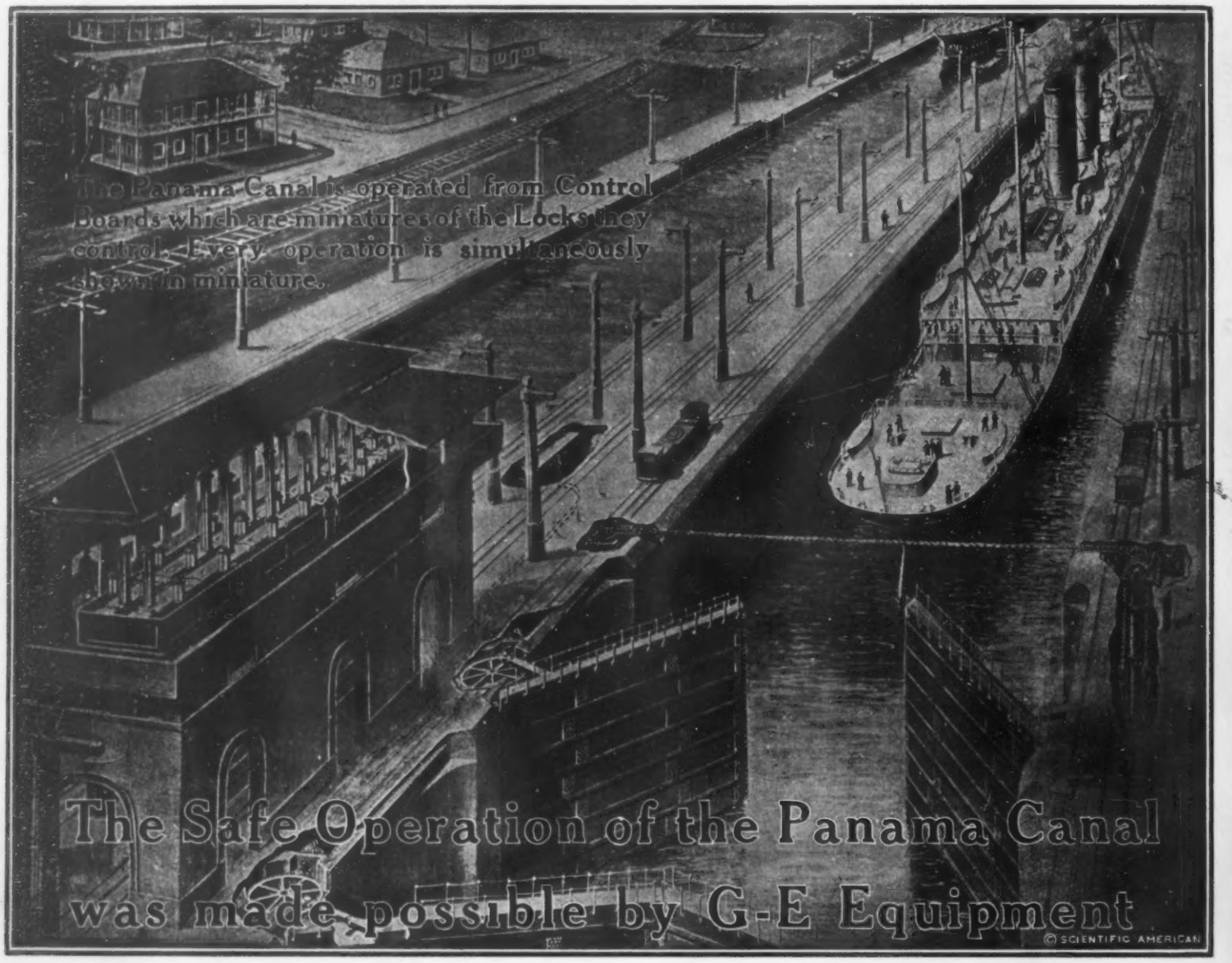
The Panama Canal is Electrically Operated by G-E Apparatus



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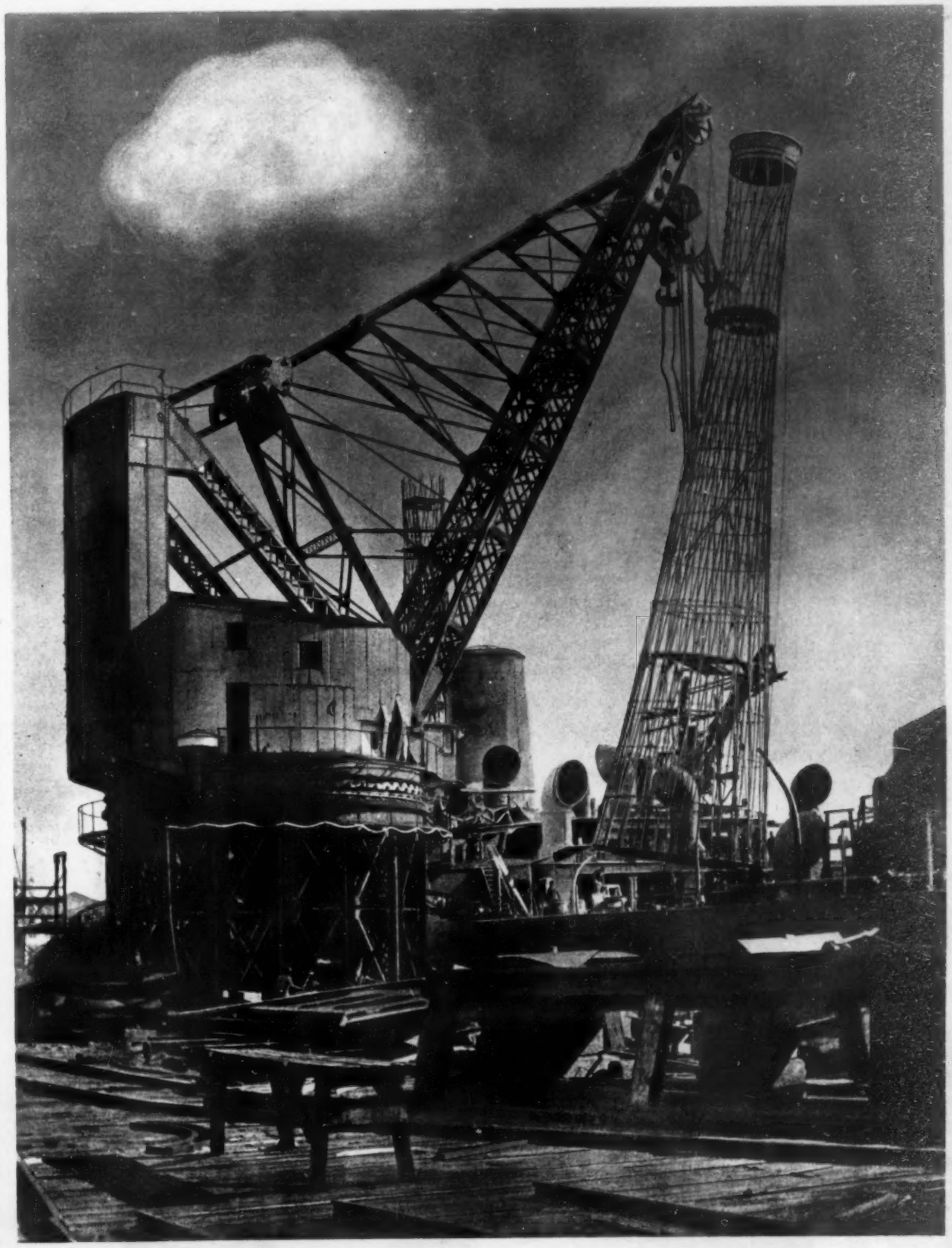

THE POWERFUL ELECTRICALLY OPERATED DERRICK "HERCULES" REMOVING A LATTICE MAST FROM A BATTLESHIP

March 10, 1917

Munn & Co., Inc., Publishers
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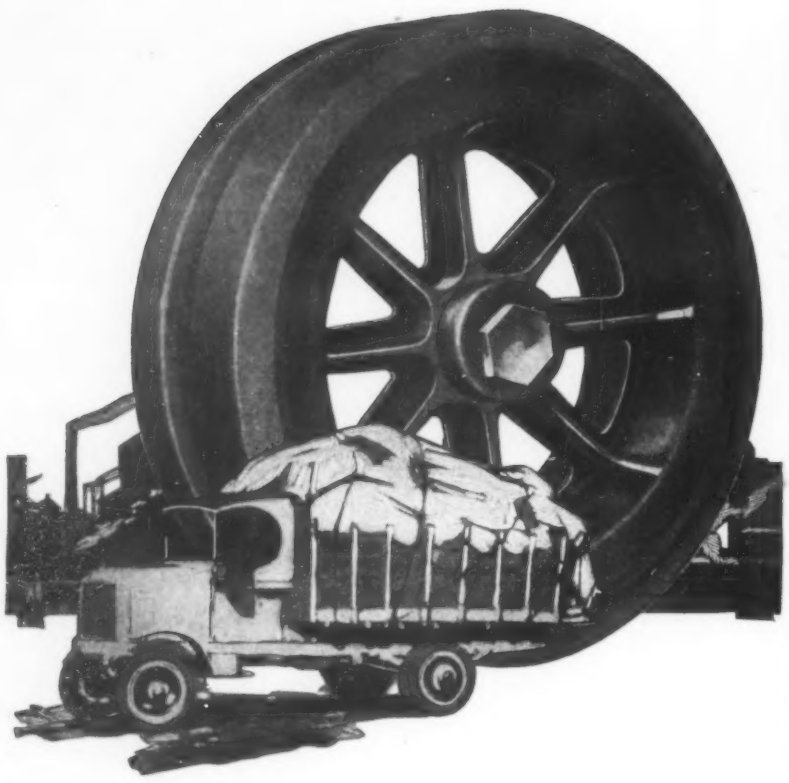

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Resilience and resistance must be provided by a single unit.

This difficult requirement has led to the trial and test of thousands of compounds—rubber combined with toughening materials.

In the Goodyear S-V we believe we have the tire most successfully compounded to withstand the greatest punishment, last for more thousands of miles, while providing a more effective buffer between the road and the load.

Users, the country over, declare the S-V is a wonder tire, incomparably better in length of life and efficiency of service.

They report mileages up to 20,000 for country use and 40,000 on city streets.

They report tire costs reduced amazingly. They declare the S-V free from common truck tire troubles, such as peeling off in strips or tearing off the edge. They report extraordinary traction, which saves power and prevents dangerous skidding.

We know that they are right. Probably it will pay you to investigate these reports of S-V excellence.

The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR
AKRON

An Ideal Summer Home

THIS beautiful little Colonial House will make an ideal home for you this summer. It has been selected by our customers as the one house of all we make, best suited to the needs of a family desirous of escaping from the dust and heat of the city. Modern business methods applied to home building have created

Bossert Houses

All the bother of construction taken off your shoulders, you benefit by our methods of buying and manufacturing. Why pay the high labor costs of today, buy the finished product and live this summer out where the woods are green.

The vital economies in labor and material effected by the Bossert permanent method, make it possible for us to sell the above house, with two 9 x 12 bedrooms, a 9 x 18 living room, kitchen and bath, with screens, lattice work, and even benches included at the surprisingly low price of

Eleven Hundred Dollars
F. O. B. Brooklyn

Two men can erect this house in three days: not even a nail to buy, it can be unassembled and put up again any number of times.

Send 12 cents today for complete catalog showing Bossert details of construction and other houses.

We also manufacture the smaller "portable" or "knock down" houses.

LOUIS BOSSERT & SONS, INC.
1305 Grand Street, Brooklyn, N. Y.

For the "One Woman" Top

DU PONT FABRIKOID
REG. U. S. PAT. OFF.

RAYNTITE

Single Texture Top Material

Rayntite is more than the ideal one-man top material. It is also ideal for the "one-woman" top.

All far-sighted automobile manufacturers recognize the growing importance of the woman in the choice of cars.

Witness the increase in the use of colored bodies, graceful designs, ornamental interiors of closed cars, and Moorish finish Fabrikoid for upholstery.

A Rayntite top is light enough for the average woman to handle, yet guaranteed not to leak for one year, and built to last as long as the car.

Trade Authority Tells of Trend

From the show number of *The Automobile* of January 4, 1917, we clipped the following:

long in arriving.

Tops Are Lighter

Tops are tending to be lighter. The old-fashioned top consisted of two layers of material, each being thick and massive. Now there are many cars with only one thickness of material, just as waterproof, less attractive to dust, and a good third lighter.

Why make your car top heavy, and the "one-man" top a joke, by using material twice as heavy as it needs to be?

Now Made in Two Varieties

RAYNTITE No. 1—Single texture with Fabrikoid surface—and
RAYNTITE No. 2—Single texture with Fairfield Rubber surface
Each is guaranteed one year against leakage

If the car you are considering is not topped with Rayntite, find out whether you or your wife can really handle the one-man top.

Samples of either variety on request

DU PONT FABRIKOID COMPANY
WILMINGTON, DELAWARE
Works at Newburgh, N. Y., and Fairfield, Conn.
Canadian Sales Office and Factory, Toronto